

INTERFACETM



MICROCOMPUTING FOR HOME AND SMALL BUSINESS/VOL. 1, ISSUE 12, NOV. 1976 \$1.50

**Build A Simple
A to D Converter**

**Protecting Stored
Programs**

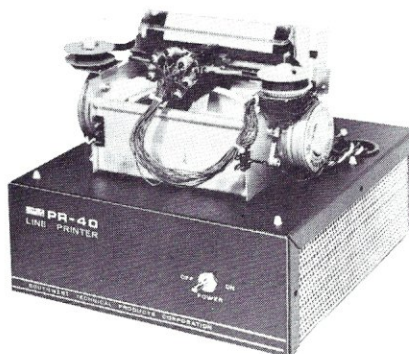
**RCA ASCII Keyboard
Modifications**

**HARDWARE/SOFTWARE
GUIDE EDITION**

NEED HARDCOPY?

If you are one of the many computer users who wants hardcopy printouts, but can't afford any of the available machines, your troubles are over. Our PR-40 is a universal printer that gives you clear easy to read hardcopy like the sample on the right with almost any computer. Our printer operates from any eight bit parallel I/O port. The printer has it's own character generator and memory buffer. This means that the computers only job is to feed data when the printer is ready. No special program is needed in the computer to convert the data to a form that the printer can use as each character is printed. The PR-40 is easy to use, easy to interface and easy to afford.

- * SWTPC PR-40 ALPHANUMERIC PRINTER *
- * 40 CHARACTERS / LINE
- * 5 X 7 DOT MATRIX IMPACT PRINT
- * USES STANDARD 3 7/8" CALCULATOR PAPER
- * 75 LINE / MINUTE PRINT RATE
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- * TTL, SWTPC 6800, MITS COMPATIBLE

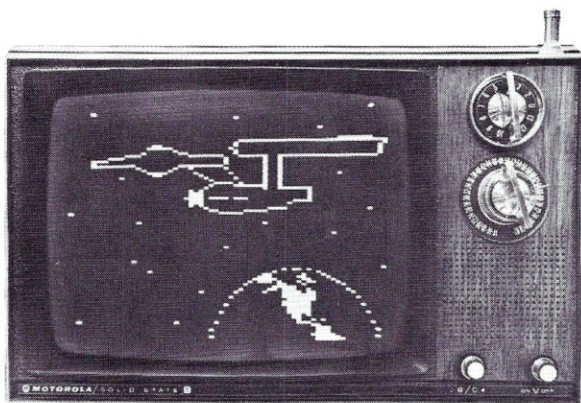


PR-40 LINE PRINTER KIT.....\$250.00 PPd

HOW ABOUT PICTURES?

Games are more fun with pictures. Now you can add graphics displays to your game programs and on any type computer. Our GT-6144 operates from any eight bit parallel I/O port. It has it's own self contained memory, so memory space for the display is not robbed from your computer. The 9½ x 13 circuit board contains all you need to produce a graphic display like the one of the starship "Enterprise" shown on the left. Kit is less power supply, or chassis.

GT-6144 GRAPHICS TERMINAL KIT . \$ 98.50 PPd



I know a bargain when I see it. Send the following:

- | | | | |
|--|----------|---|----------|
| <input type="checkbox"/> 6800 Computer | \$395.00 | <input type="checkbox"/> PR-40 Printer | \$250.00 |
| <input type="checkbox"/> GT-6144 Graphics Terminal | \$ 98.50 | <input type="checkbox"/> Just data (free) | |

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Southwest Technical Products Corp.
Box 32040, San Antonio, Texas 78284

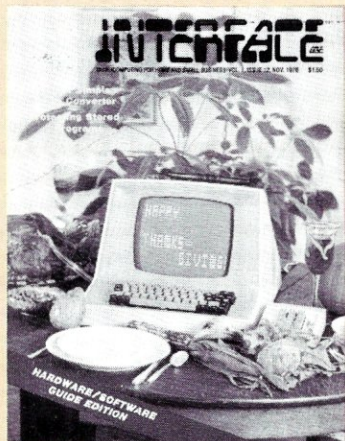


Photo by E-tronics
Culver City, CA.

Cover Story

Depicted on our cover is a scene of calm, plenty and electronic tranquility.

We reflect upon the progress and prosperity of our time in keeping with the season and realize that all our material well being is a product of not only ours, but someone else's dreams, hard work and successes.

The micro computer and its impact on today's life style has been, for the most part, a very positive event not only bringing engineering dreams into reality but also bringing together the family through leisure time activities.

We at INTERFACE AGE wish you a happy Thanksgiving season.

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INTERFACIAL



'Tis the season to be jolly, for around the corner comes that old lovable CPU himself with his eight high speed PROMS carrying good wishes for all and peripherals too.

Helping to provide that last minute update to the shopping list is a wealth of new product entries. Based on the overwhelming success of the Hardware Directory in July's issue (over 65,000 inquiries) we herein are providing an extensive addition for your convenience.

Most of you are probably familiar with the RCA ASCII keyboard which has been on sale in the surplus market place over the past several months. Digging into the system with the proper modifications has posed a problem due to lack of good documentation.

Larry McDavid, engineer and computer hobbyist has reflected on this subject and provides an excellent insight into what must be done to make it work for you.

Since documentation on 6502 and 6800 based systems are becoming more prolific, we are pleased to include in this month's issue "Building a Simple A to D" by Stephen Wozniak. This feature is a quick little project to add hours of enjoyment to your personal computing activities.

Returning to the Superchip FD1771, Roger Edelson, Hardware Editor, continues to explore the device in terms of the command structure and status information available from the chip.

Protecting one's own software for long periods of time requires some special

considerations.

Bill Sevedge discusses the obvious and the *not* so obvious pitfalls of home storage and the preventative measures to be taken.

Software, the most important element to all successful small business and personal computing activities is further extended in the Software Section edited by Bob Stevens.

Gary Kay, resident software wizard at Southwest Technical Products offers a rotating bit memory diagnostic program design to check for and locate memory retaining problems in the SWTPC 6800 computer system memory boards.

Floating Point routines for the 6502 by Roy Rankin and Steve Wozniak provide valuable tools for the math based applications both in small business and personal computing fields.

"Black Jack in Basic" by Ed Keith is a far more sophisticated program than ever presented before in any publication to date. This version allows both splitting pairs and doubling down and also gives you the option of one to four decks.

High speed double precision multiplication and re-entrant 16 bit divide sub routines are offered by Motorola user library to readers of INTERFACE AGE.

It is our policy to dedicate the contents of this publication to our readers — it is through your voice that we present hopefully what you've been looking for.

The Editor

INTERFACE AGE

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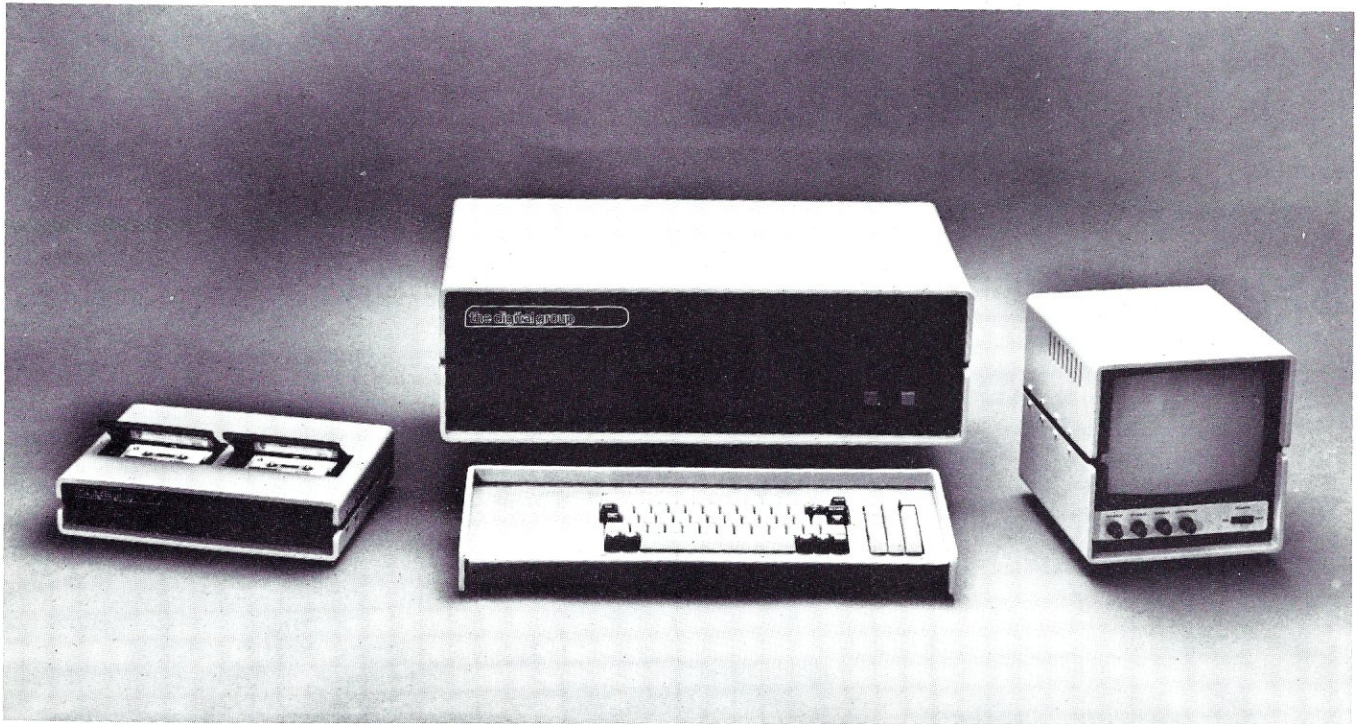
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Direct all correspondence to the appropriate editor at: INTERFACE AGE magazine, P.O. Box 1234, Cerritos, CA 90701. Editorial contributions must be accompanied by return postage and will be handled with reasonable care, however, publisher assumes no responsibility for return or safety of manuscripts, art work, or models.

ADVERTISING INQUIRIES

Direct all advertising inquiries to: Advertising Department, INTERFACE AGE magazine, 61 South Lake Avenue, P.O. Box 4566, Pasadena, CA 91106—(213) 795-7002.

Made for each other



by the Digital Group...who else?

There's a simple reason why a system from the Digital Group looks like it belongs together: It was designed that way. And the look is fantastic.

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Update

DRAFT OF PROPOSED ANSI FORTRAN STANDARD AVAILABLE FROM ACM

The draft proposal of the American National Standard FORTRAN, published as the March, 1976 issue of ACM SIGPLAN Notices, is available at \$5, prepaid, from the ACM Order Department, P.O. Box 12105, Church Street Station, New York, N.Y. 10249. This document should be part of every FORTRAN programmers' technical library.

The proposed standard, developed by the ANS Committee X3J3, consists of a full language and a subset language as a revision of X3.9-1966 FORTRAN. The Committee has recommended withdrawal of X3.10-1966 Basic FORTRAN.

Based on comments received by the Committee, the proposed standard will be revised as necessary and submitted to the American National Standards Committee X3 for letter ballot and final approval.

New Distributor: CYBERDUX

Microcomputer Applications
1210 Santa Fe Drive
Encinitas, CA 92024
Phone (714) 279-4189
or 436-5594

Cyberdix Microcomputer Applications is a new distributor for the SWTPC M6800 computer system, providing them in both kits and assembled units. They also provide customers with repair service at reasonable prices and often offer substantial discounts on the items they sell. In addition, they provide hardware and software consulting support to commercial or educational users.

NEW CLUBS

Formation of the British Columbia Computer Society was announced on October 10.

The first (organizational) meeting was held on September 8, 1976 and had an attendance of 19 people. The size of the

group has since doubled and promises to continue growing rapidly.

Meetings are at 8 p.m. every first Wednesday of the month in room 129 at the British Columbia Institute of Technology.

For more information contact: Karl Brackhaus, 203-1625 W. 13th Ave., Vancouver, B.C., Canada V6J269. Phone: (604) 738-9341.

CALL FOR PAPERS AND PARTICIPATION

THE FIRST WEST COAST COMPUTER FAIRE

This is intended to be both a call for papers, suggestions, and participation, as well as an announcement of the forthcoming Computer Faire.

The first major convention to be held on the West Coast, exclusively concerned with personal and home computers, will take place April 15-17, 1977. The First West Coast Computer Faire will be held in the largest convention facility in Northern California, taking over the entire Civic Auditorium in San Francisco's Civic Center. It is expected to draw 7,000 to 10,000 people for the two and a half days of talks and exhibitions. The Conference portion of the Computer Faire is expected to offer 50-100 tutorials, informal presentations, formal papers, and discussion sessions. The Exposition portion of the Faire will place a variety of "homebrewed" personal computer systems on display, as well as presenting a massive exhibition of low-cost and exotic computer systems, components, and peripherals available from commercial vendors. Over 200 such commercial exhibits are expected.

Interested parties are encouraged to offer suggestions and volunteer to participate in the Computer Faire. Suggestions and volunteers concerning the following are particularly sought: Possible speakers, interesting topics, Conference Section Chairpeople, interesting homebrew exhibits (hardware or software), appropriate commercial exhibitors, possible special activities, etc. Suggestions and questions

should be directed to either: Jim Warren, Faire Chairperson, Star Route Box 111, Woodside, CA 94062; (415) 851-7075; 851-7664; 323-3111; or, Bob Reiling, Operations Coordinator, 193 Thompson Square, Mountain View, CA 94043; (415) 967-6754 [W6JHJ].

Note: Jim is Editor of *Dr. Dobb's Journal of Computer Calisthenics & Orthodontia*, Vice Chairman of the Association for Computing Machinery's San Francisco Peninsula Chapter. Bob is Editor of the *Homebrew Computer Club Newsletter*, the publication of the second-largest organization of computer amateurs in the United States.

A considerable variety of Conference Sections are being planned. These include:

- Personal Computers for Education, which will have associated with it, a University of California short-course
- Computer Graphics on Home Computers
- Computer-driven & Computer-assisted Music Systems
- Personal Computers for the Physically Handicapped
- Computers & Amateur Radio
- Hardware, Software & Systems for Home Word Processing
- Speech Synthesis Using Home Computers
- Computers & Systems for Very Small Businesses
- Microprogrammable Microprocessors for Hobbyists
- Digital Cassette Tape Standards
- Program & Data Input via Optical Scanning of Bar Coded Information
- Peripherals Interface & Bus Standards
- Software Design, Modularization & Portability
- Floppy Disc Systems for Home Computers
- Computer Games — Alphanumeric & Graphic
- Discussion Sections for Computer Club Officers, Convention Organizers, Club Newsletter Editors, etc.

Other Conference Sections will be added as topics are proposed and speakers are found.

The Computer Faire has a broad range of sponsorship from local and regional computer education organizations. Co-sponsors currently are:

- The two largest amateur computer organizations, the Homebrew Computer Club and the Southern California Computer Society
- Both of the area Chapters of the Association for Computing Machinery, the San Francisco Peninsula Chapter, and the Golden Gate Chapter
- California Mathematics Council
- The Community Computer Center and the People's Computer Company, both being California-chartered non-profit educational organizations

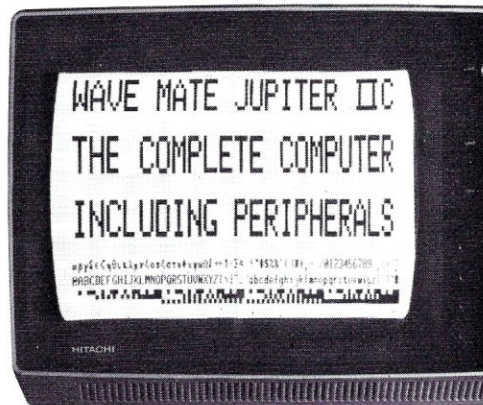
BRANCH TO PAGE 10

Now we're on TV!

Wave Mate introduces Jupiter IIC, a complete computer system incorporating a monitor quality TV interface. This system provides everything you need to create and run application programs. Jupiter IIC includes a CPU with 8K dynamic RAM and 3K ROM memory, video terminal interface and keyboard, and dual audio cassette tape interface. The TV interface features upper and lower case and

Greek character sets, and dot graphics. The dual audio cassette interface provides start/stop operation and operates at 300, 600, or 1200 baud.

And of course we still provide these high-quality features: burn-in tested IC's, socketed IC's, complete documentation, and more.



ATTENTION: ORIGINAL EQUIPMENT MANUFACTURERS

Jupiter IIC provides OEMs with the tools to get systems into the field faster and at lower cost. (1) Use Jupiter IIC as your development system. Perfect for development of software and special hardware. (2) Use Jupiter IIC for prototype systems. Only Wave Mate provides the tools — wire wrap modules, universal modules, complete documentation — to easily tailor system logic and add customized interfaces within the basic Jupiter IIC package.

SOFTWARE

All Jupiter IIC systems feature a sophisticated monitor/debugger package including a versatile interrupt system and I/O monitor call instructions. A programmable macro editor and expanded assembler are also provided. Proposed ANSI standard BASIC is included with Jupiter IIC.

THE JUPITER IIC KIT: \$2850

The kit includes the CPU, software debugger and monitor module, 8K dynamic memory, module cage, power supply, front panel, video interface, cassette interface, and all the documentation required to assemble, run, and understand the system as well as modification instructions for a black and white TV set.

THE JUPITER IIC ASSEMBLED SYSTEM: \$3800

All components of the Jupiter IIC kit plus two audio cassette units and a 12-inch black and white TV set. The complete system is shipped with all components assembled and tested.

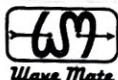
SPECIFICATIONS

CPU
MC 6800; eight-level interrupt, prioritized and maskable by level; single-cycle and block DMA

DUAL AUDIO CASSETTE
Complete paper tape replacement; start/stop motor control; 300, 600, or 1200 baud (crystal controlled); error correction

VIDEO TERMINAL INTERFACE
64 x 32 lines; Upper and lower case, plus Greek alphabet; 7 x 12 format, 128 dot (hor.) x 96 dot (vert.) graphics

MEMORY
8K dynamic RAM; 3K ROM; 1K dual-port static RAM
KEYBOARD
Generates full 128-character ASCII set



WAVE MATE 1015 West 190th Street, Gardena, California 90248
Dept. 201

Telephone (213) 329-8941

- ☐ Send details on Jupiter II systems
☐ Have salesman call

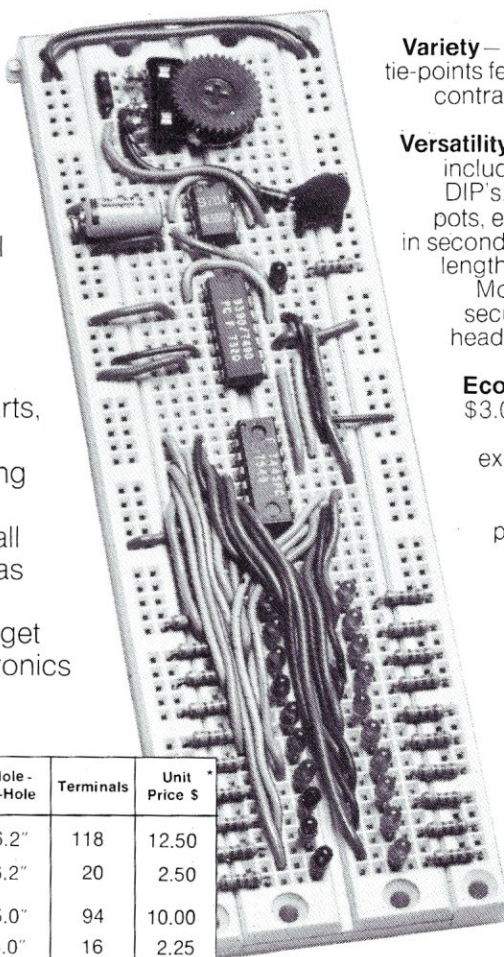
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EVERY PROJECT IN THIS BOOK IS ANOTHER REASON TO OWN CSC'S QT SOCKETS AND BUS STRIPS.

With QT solderless bread-boarding sockets and bus strips, you can build twice the projects in half the time. Because making connections or circuit changes is as fast as pushing in—or pulling out—component leads. No special clips or jumpers required, either.

When you're building circuits just for the fun of it, you can take them apart in minutes—not hours. So you save money by re-using parts, while eliminating heat damage to expensive components. Interlocking QT Sockets and Bus Strips are infinitely expandable, too: start small and "grow" breadboards as large as you wish.

For as little as \$3.00, you can get a lot more out of your time in electronics—so why not treat yourself to a QT Socket today?



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Molded-in holes let you mount QT units securely on any flat surface with 4-40 flat head screws, or 6-32 self-tapping screws, from behind panel.

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Length Hole - to-Hole		Length	Hole - to-Hole	Terminals	Unit Price \$
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	QT-59B	6.5"	6.2"	20	2.50
	QT-47S	5.3"	5.0"	94	10.00
	QT-47B	5.3"	5.0"	16	2.25
	QT-35S	4.1"	3.8"	70	8.50
	QT-35B	4.1"	3.8"	12	2.00
	QT-18S	2.4"	2.1"	36	4.75
	QT-12S	1.8"	1.5"	24	3.75
	QT-8S	1.4"	1.1"	16	3.25
	QT-7S	1.3"	1.0"	14	3.00

All QT units are .33" thick.

See your CSC dealer or call
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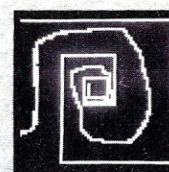
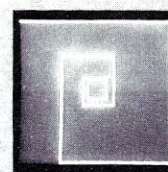
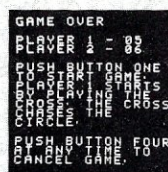
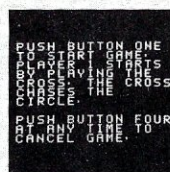
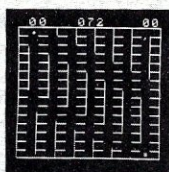
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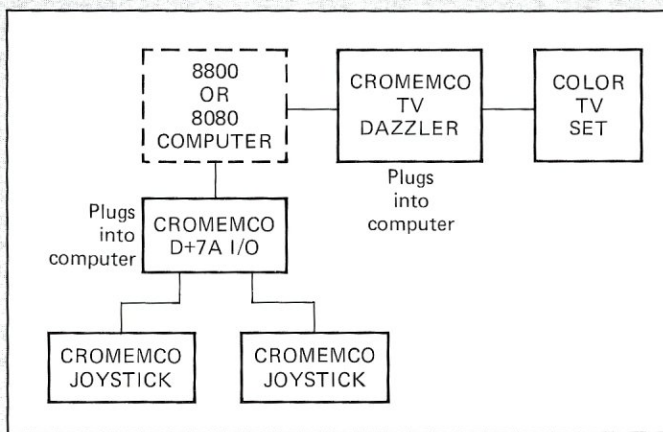
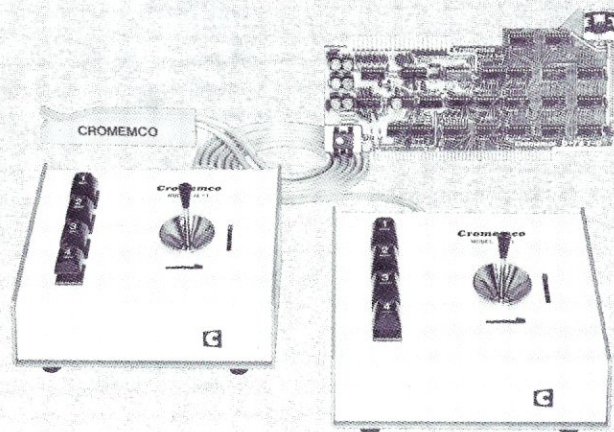
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You get more games, more fun, more computer uses with this new joystick



AND THERE'S AN EASY WAY TO INPUT IT TO YOUR COMPUTER

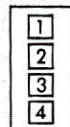
You'll get a lot more fun out of your computer with this new joystick.

But note that it is not just an ordinary joystick — it is a *console*. It has a 2-axis joystick and contains a *speaker* and *speaker amplifier*. You can have *sound* with your games or, say, warning sounds in other applications. Or have your computer talk to you.

Gives you
sound, too



Four
pushbuttons



A third feature you get is *four pushbutton switches*. These give you even more possible uses such as selecting various colors on a color graphics terminal.

EASY TO COUPLE

To couple the new joystick to your computer, just use our D+7A™ I/O board. It will couple not only one but two consoles to your Altair™

8800 or IMSAI 8080. And you'll still have several analog channels left over (and one 8-bit output port).

The D+7A plugs into the Standard 100 (S-100) bus of your Altair or IMSAI computer.

EASY TO DISPLAY

Displaying the joystick outputs with the software below is also easy. Just use our TV DAZZLER™ board. It also plugs into the S-100 bus.

NEW SOFTWARE

Here's some new Cromemco software for the joystick (to display, use DAZZLER interface):

CHASE! (2 persons, 2 joysticks): the cross chases the circle. The vertical bars move downward to add more fun to the chase. Score and remaining time kept automatically.

TRACK (1 person, 1 joystick): move the dot to the center of the spiral without touching the spiral's arms.

DAZZLE DOODLE (1 person, 1 joystick): lets you draw pictures in 4 colors on your color TV terminal using the joystick.

STORE/MAIL

Cromemco wishes you more fun, more use from your computer. Get this new joystick console and other Cromemco peripherals at your computer store or order from the factory.

Joystick console kit (Model JS-1K)	\$ 65
Joystick console assembled (Model JS-1W)	\$ 95
D+7A I/O kit (Model D+7A-K) ..	\$145
D+7A I/O assembled (Model D+7A-W)	\$245
TV DAZZLER kit (Model CGI-K) ...	\$215
TV DAZZLER assembled (Model CGI-W)	\$350

SOFTWARE

(Punched paper tape
with documentation)

CHASE!	\$15
TRACK	\$15
DAZZLE DOODLE	\$15

PROMPT SHIPMENT

Mastercharge and BankAmericard accepted with signed order. Please show complete card number and expiration date.
Mail orders shipped prepaid if fully paid with order. Purchase orders accepted subject to credit approval.

California users add 6% sales tax.



Cromemco

Specialists in computers and peripherals

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Letters to the Editor

Dear Editor:

I have just sent in my subscription to your magazine *INTERFACE AGE* a few days ago and I want to say I am very pleased with the one issue I read.

I am a charter subscriber to *BYTE*, *Personal Computing* and *KILOBYTE*, and I feel that your magazine offers more in all-around software features, though not enough hardware features. The ads in *INTERFACE* are very noticeable and well laid out.

One question: are back issues available? I'm very interested in catching up and completing my library.

Thank you for your kind attention. I hope to be hearing from you soon.

Art Surges
Evergreen Park, Ill. 60642

Dear Editor:

Having just purchased my first copy of *INTERFACE AGE* I want to express my congratulations to you and your staff for an excellent job on the quality of material in the magazine. In response to your survey I have the following items:

I'm a beginner to the field of computers but have been involved in electronics for some time. I enjoy any article which provides an easy, understandable approach to logic circuitry. If possible, I'd like to see articles which provide a few experimental projects that hobbyists could put together on breadboards.

Another area for future article consideration might be practical mini- or microcomputer applications for hobbyists. I eventually would like to have a small system in my home but I'd like to see what other experimenters have been doing.

Finally, could you publish any info about obtaining back-issues of *INTERFACE*. My local magazine stand has just started carrying it and since it's relatively new I'd like to get all of the previous issues. I'm sure other readers would be

interested.

Again, congratulations on a fine job you're doing.

Jay W. Bradbury
San Francisco, CA

We are sorry to inform you & our readers that the only back-issues available now are the APRIL, MAY, JULY, AUG and OCTOBER issues. You may receive them by sending \$1.75 + 50¢ for each copy postage & handling to Interface Age-BI, P.O. Box 1234, Cerritos, CA 90701

Editor

Dear Editor:

On October 13, I received the September issue of *INTERFACE AGE*. I know that magazines sometimes arrive late, but this is ridiculous. The calendar and advertising is almost two months out of date by the time I get the magazine. It has been consistently late for the last 3 months. Do I blame you or the Post Office? Your magazine is great, but I want it on time.

Bob Burgus
West Des Moines, IA 50265

We can understand the frustration you must feel but there are some very good reasons for this apparent problem.

1. *To serve our readers best we go to press between the 3 and 4 week preceding the date of issue. This means that Interface Age is far more current at press time than any other monthly publication.*

Interface Age is distributed the first week of the issue month.

Most all publications have deadlines 6-8 weeks prior to distribution, ours is 20 days!!

2. *Due to the Postal delays in getting the publication to the East Coast, an average of 2-3 weeks are lost. Hark! help is on the way — we have opened a new mailing point on the East Coast and this should put an end to this delay starting in January. All East Coast *INTERFACE AGE* magazines are going by Air Freight to the Post Office.*

3. *Your letter was dated Oct. 25 — surprised? Thank you for your concern.*

Editor

The Intecolor® 8001 Christmas Kit Is Now Available Through The Following Authorized Distributors



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- The Amateur Research Center, affiliated with the Foothill College Space Science Center

- The Professional and Technical Consultants Association

Resolutions of co-sponsorship are currently under consideration by still other local and state organizations.

Even though the prospectus for commercial exhibitors has not yet been printed, a number of vendors have already committed to presenting their products at the Faire. These include:

- Zilog
- AMI (American Microsystems, Inc.)
- Byte Magazine
- *Dr. Dobb's Journal of Computer Calisthenics & Orthodontia*
- 73 Magazine
- *Northern California Electronic News*
- *Minicomputer News*
- *Personal Computing*
- MITS
- Processor Technology
- Cromemco
- OSI (Ohio Scientific Instruments)
- Technical Design Labs
- Polymorphic Systems
- Intel
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- MOS Technology
- *INTERFACE AGE*
- *People's Computer Company* newspaper
- *Microcomputer Digest*
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and so on. Additionally, a number of the larger companies are currently working on obtaining management approval for joining the exhibitors. Incidentally, these

commercial exhibitors will be allowed to sell the products at the Faire and will, in many cases, be offering special reduced rates for those who attend the Faire.

A large number of door prizes will be given away at the Faire. Additionally, prizes will be awarded for the most outstanding homebrewed computer exhibits . . . just like the home cookin' prizes of the old country fairs.

CALENDAR

Nov. 3 New England Computer Society meets 7 p.m. at Mitre Corp. near routes 3 and 62 in Bedford, MA.

Nov. 3 SCCS Valley Chapter meeting at 7:15 p.m., Harvard School Auditorium, 3700 Coldwater Canyon, Studio City, CA.

Nov. 5 Amateur Computer Group of New Jersey. 8080/Z80 Users Group meets at 7 p.m., Union County Technical Institute, Scotch Plains, N.J.

Nov. 7 North Orange County Computer Club, meeting 1 p.m. at Cal State Fullerton, Administration Bldg., 3rd Floor. For more information contact Patrick Powers (714) 544-0580 or Loren Mahler (714) 998-5831.

Nov. 8 IEEE—3rd International Joint Conference on Pattern Recognition (8th-11th) at Hotel del Coronado, Coronado, Calif. For complete information contact IEEE (301) 439-7007.

Nov. 9 SCCS—Santa Monica Bay Chapter, Veterans Administration Hospital, Bldg. 114, Room 125 at 7:15.

Nov. 12 Homebrew Computer Club meets at 7 p.m., Stanford Accelerator Center Auditorium.

Nov. 17 IEEE—Computer Networks—Trends and Applications meeting at National Bureau of Standards, Gaithersburg, MD.

Nov. 19 Long Island Computer Association (LICA), meets at New York Institute of Technology, Bldg. 500, Room 506 at 8 p.m. Topic: Mostek Z80. Newsletter: *The Stack*. For more information contact Morris Balamut, P.O. Box 864, Jamaica, N.Y. 11431.

Nov. 19 Amateur Computer Group of New Jersey, meets at 7 p.m., Middlesex County College in Edison, N.J.

Nov. 21 The Cleveland Digital Group meets at 2 p.m., 8700 Harvard Ave., Cleveland, Ohio.

Nov. 22 The Minnesota Computer Society will hold their meeting at Hennepin County Library, Southdale Branch, 7001 York Avenue S, Edina, MN 55435. Contact

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All the computer stores listed above have Apples on the shelf, ready to go.

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Apple Introduces the First Low Cost Microcomputer System with a Video Terminal and 8K Bytes of RAM on a Single PC Card.

The Apple Computer. A truly complete microcomputer system on a single PC board. Based on the MOS Technology 6502 microprocessor, the Apple also has a built-in video terminal and sockets for 8K bytes of on-board RAM memory. With the addition of a keyboard and video monitor, you'll have an extremely powerful computer system that can be used for anything from developing programs to playing games or running BASIC.

Combining the computer, video terminal and dynamic memory on a single board has resulted in a large reduction in chip count, which means more reliability and lowered cost. Since the Apple comes fully assembled, tested & burned-in and has a complete power supply on-board, initial set-up is essentially "hassle free" and you can be running within minutes. At \$666.66 (including 4K bytes RAM!) it opens many new possibilities for users and systems manufacturers.

You Don't Need an Expensive Teletype.

Using the built-in video terminal and keyboard interface, you avoid all the expense, noise and maintenance associated with a teletype. And the Apple video terminal is six times faster than a teletype, which means more throughput and less waiting. The Apple connects directly to a video monitor (or home TV with an inexpensive RF modulator) and displays 960 easy to read characters in 24 rows of 40 characters per line with automatic scrolling. The video display section contains its own 1K bytes of memory, so all the RAM memory is available for user programs. And the

Keyboard Interface lets you use almost any ASCII-encoded keyboard.

The Apple Computer makes it possible for many people with limited budgets to step up to a video terminal as an I/O device for their computer.

No More Switches, No More Lights.

Compared to switches and LED's, a video terminal can display vast amounts of information simultaneously. The Apple video terminal can display the contents of 192 memory locations at once on the screen. And the firmware in PROMS enables you to enter, display and debug programs (all in hex) from the keyboard, rendering a front panel unnecessary. The firmware also allows your programs to print characters on the display, and since you'll be looking at letters and numbers instead of just LED's, the door is open to all kinds of alphanumeric software (i.e., Games and BASIC).

8K Bytes RAM in 16 Chips!

The Apple Computer uses the new 16-pin 4K dynamic memory chips. They are faster and take 1/4 the space and power of even the low power 2102's (the memory chip that everyone else uses). That means 8K bytes in sixteen chips. It also means no more 28 amp power supplies.

The system is fully expandable to 65K via an edge connector which carries both the address and data busses, power supplies and all timing signals. All dynamic memory refreshing for both on and off-board memory is done automatically. Also, the Apple Computer can be upgraded to use the 16K chips when they become availa-

ble. That's 32K bytes on-board RAM in 16 IC's—the equivalent of 256 2102's!

A Little Cassette Board That Works!

Unlike many other cassette boards on the marketplace, ours works every time. It plugs directly into the upright connector on the main board and stands only 2" tall. And since it is very fast (1500 bits per second), you can read or write 4K bytes in about 20 seconds. All timing is done in software, which results in crystal-controlled accuracy and uniformity from unit to unit.

Unlike some other cassette interfaces which require an expensive tape recorder, the Apple Cassette Interface works reliably with almost any audio-grade cassette recorder.

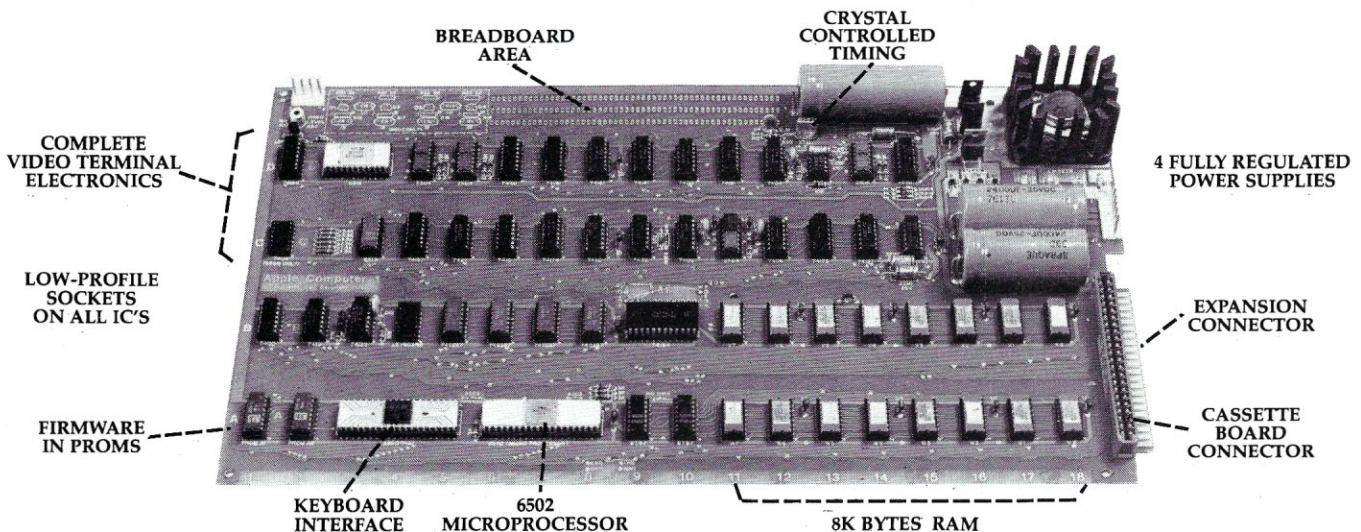
Software:

A tape of APPLE BASIC is included free with the Cassette Interface. Apple Basic features immediate error messages and fast execution, and lets you program in a higher level language immediately and without added cost. Also available **now** are a dis-assembler and many games, with many software packages, (including a macro assembler) in the works. And since our philosophy is to provide software for our machines free or at minimal cost, you won't be continually paying for access to this growing software library.

The Apple Computer is in stock at almost all major computer stores. (If your local computer store doesn't carry our products, encourage them or write us direct). **Dealer inquiries invited.**

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* includes 4K bytes RAM



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BUILD A SIMPLE A TO D

by Stephen Wozniak
Apple Computer Co.

Now and then, we computer hobbyists find ourselves caught between the compulsion to do something new with our system ("what do I do now?") and the constraints of finite resources, both financial and psychological. Even motivation melts away when the next peripheral lies days or weeks of labor away. Just as a single play on a pinball game may last for hundreds of rebounds, occasionally a very simple project provides years of enjoyment and usefulness. Herein is described an extremely simple interface for reading analogue data, in the form of a pot position. Although developed for the APPLE-1 computer, it is easily modified to work on other 6502- or 6800-based systems.

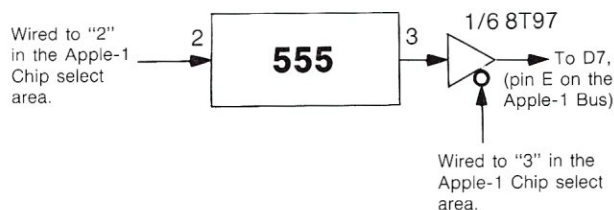
HARDWARE

The 'dial' (or paddle) circuit works as follows. Two addresses must be assigned to the circuit by the user (one for read, one for write). You should choose some convenient address not already assigned to RAM, ROM, or other I/O devices such as keyboards. The examples in this article assume that the addresses 2XXX and 3XXX (where X means 'any hex digit will work') are used for writing and reading respectively. You need not provide full I/O ports, just the address decoding.

The output assignment (2000 hex) is labelled PSTRB and is used to strobe (trigger) a 555 timer IC configured as a 1-shot (monostable multivibrator). Upon decoding this address, a short (approximately 1 usec) low-going pulse is applied to pin 2 of the 555 which sets the output (pin 3) high. After a delay, which varies with the dial control pot setting, the output returns low and remains. The duration of this output is measured by a user subroutine, PREAD, which detects the 555 state by means of the I/O assignment PDATA (3000 hex). If you have an existing input port, you may use it for PDATA and neglect the 8T97 tri-state bus driver shown on the schematic.

TESTING ON AN APPLE-1 SYSTEM

1. A simple test configuration is used to test the timer.



555, wired as shown in schematic.

2. Store the PREAD subroutine in memory locations 0 through 10 (hex).

3. Store the following assembly language program in memory locations 11 to 20 (hex). If you have APPLE-BASIC then you may wish to proceed to the section on testing the dial circuit from BASIC, instead.

0011	20 00 00	PTEST	JSR	PREAD	Read control pot.
0014	A5 10		LDA	PSAV	Get count.
0016	20 DC FF		JSR	PRBYTE	Print it in hex.
0019	A9 A0		LDA	#\$A0	Ascii blank.
001B	20 EF FF		JSR	ECHO	Print it.
001E	4C 11 00		JMP	PTEST	Do it again.

Note that addresses FFDC and FFEF were used for ECHO and PRBYTE subroutines, corresponding to entry points in the APPLE-1 hex monitor. If you are testing on a non-APPLE system, ECHO must output the A-REG as an ASCII character, and PRBYTE must output it as two hex digits. No other restrictions apply (i.e. the A-REG contents may be disturbed, along with the contents of the other registers, X and Y)

4. Run PTEST by typing 11R from the hex monitor. The screen will continually output (in hex) dial positions. Adjusting the dial should result in values between 0 and 40 (hex). If 0 is printed for all settings, then it is likely that (a) your dial control pot is of the wrong value; (b) your circuit is wired wrong; or (c) the PSTRB address is assigned improperly (it should be 2000 hex). If the PREAD subroutine hangs up then it is likely that (a) your dial control pot is of the wrong value; (b) your circuit is wired wrong; (c) the PREAD and PTEST pro-

grams are not correct in memory; or (d) the PDATA address is assigned improperly (it should be 3000 hex). If addresses are improperly assigned, check that the PSTRB and PDATA lines are properly strapped to the "2" and "3" (2XXX and 3XXX hex) blocks in the APPLE-1 chip select area.

THINGS TO DO

You may wish to substitute a control pot of a value other than 100K for a different range or resolution. For example, a 200K pot gives roughly twice the range (0 to 120) and greater resolution. Be careful to shield any long wires to the control pot and not to touch the terminals on it with your fingers as this can cause the reading to 'jitter'.

A low-cost analogue dial can provide an often-overlooked advantage over keyboard or sense-switch entry. As an example, a BASIC program performs the trivial task of asking the user how many characters per line to use. The user has to type in "40" or whatever each time he runs the program. An alternative is to use a dial. If the program is written to scan the dial each time through a major loop, then the user can conveniently alter the parameter without halting the program. The convenience of dials is even greater when multiple parameters must be played against one another (such as what combination of colors yields an attractive game). Applications for dials include positioning items on video displays, music or voice synthesizers, and setting timers.

One caution — if the PREAD subroutine is interrupted while executing, inaccurate readings will result. Therefore it is recommended to disable the processor interrupt while reading the dial with PREAD.

TESTING WITH APPLE-BASIC

The following test procedure may be used if you have APPLE-BASIC.

1. Load BASIC on your ACE (APPLE Cassette Interface)
2. Run BASIC as normal by typing E000R from the hex monitor.
3. Run the following BASIC program:

```
10 CALL 0: PRINT PEEK (16); " ";
20 GOTO 10
```

Note that CALL 0 calls the PREAD subroutine at location 0 and PEEK (16) recovers the result (pot position) from memory location 16 (decimal).

The screen should continuously print dial positions from 0 to approximately 60 (this time in decimal!). Error conditions may be diagnosed by referring to the section on assembly language testing.

Solder is for sissies.

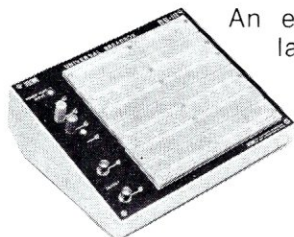
Are you still designing circuits the old fashioned way? Soldering and unsoldering? Burning up valuable IC's? If so, it's time you made a switch to solderless breadboarding. E&L Instruments offers a complete line of breadboarding products from sockets to the most complete systems for professional use. Here are five ways you can go solderless . . .

SK-10 Socket



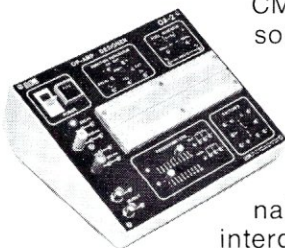
This precision solderless breadboarding socket will pay for itself in one afternoon. Integrated circuits and discrete components insert directly, without adapters. All interconnections are made with 20 to 26 gage solid conductor wire. \$17.75.

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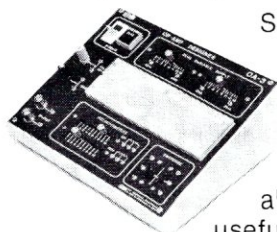
An economical approach to a large breadboarding area. Three SK-10 sockets, four 5-way binding posts, two BNC connectors, six BP-22 solderless breadboarding pins. \$65.00.

Op-Amp Designer #OA-2K



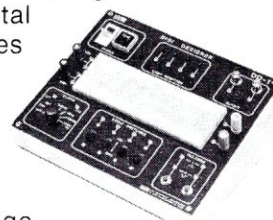
Powerful design tool for linear work and CMOS digital circuitry. SK-10 socket. Heavy current capacities on all three power supplies [$\pm 15V$ & $+5V$ DC]. Sensitive null detector and a full function generator with external frequency adjustment. All interconnections are solderless. \$95.00 in kit form.

Op-Amp Designer #OA-3K



SK-10 socket. Plus and minus variable supplies (1 to 15V). This adjustable feature makes the unit exceptionally flexible, allowing it to be more useful for odd voltage requirements. The fixed 5 volt supply allows interfacing with TTL circuitry. \$80.00 in kit form.

Digi-Designer #DD-1K



A must for every student, engineer or technician doing digital circuit design. Handles both IC and discrete components without soldering. Connections to the SK-10 socket are made using any solid 22 gage insulated wire. The DD-1K includes a clock, power supply, logic lights, pulsers, logic level switches and much more. All circuitry is now in one circuit board. \$70.00 in kit form.



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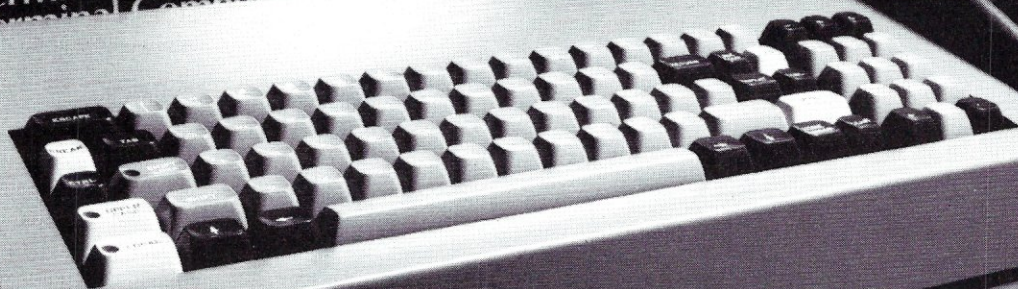
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The first complete small computer.

As you thumb through this magazine, you'll see a lot of ads for small computers. For \$600 you can find a pretty good box with a power supply, four slot mother board, CPU module, and all the expected lights and switches.

But you know what? It won't work.

That's because in order to make the computer go you have to buy memory — normally both read-write (RAM) and read-only (PROM), interfaces to the outside world (parallel, serial, and cassette), keyboard, video display module, and software.

Add this all up and it's going to cost you at least \$1,400 for a complete system. Got the picture?

Now listen to this. The remarkable new Sol-20 Terminal Computer will give you all of the above...plus more!...as *standard equipment* for just \$995, in kit form. This is because the Sol-20—like no other small computer—was designed from the ground up to be complete.

Here's what the Sol-20 includes as standard equipment:

- 8080 microprocessor.
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- A beautiful case with solid walnut sides.
- Software that includes a preprogrammed PROM personality module and a cassette with BASIC-5 language plus two sophisticated computer video games.
- Full expansion capability with all S-100 bus (Altair/IMSAI/PTC bus) products.

It's a handsome terminal or computer that will even look good in your living room or office. Small systems start at just \$475.

Full expansion capability

The Sol-20 system can be tailored to your applications using the complete line of peripheral products from Processor Technology. These include the video monitor, audio cassette and digital tape systems, dual floppy disc system, memories, and interfaces...plus all other peripherals compatible with the S-100 bus.

The Sol-20 greatly simplifies the computer-buying process. It's a splendid package that will excite both present and prospective computer owners.

Our brochure tells all. Write for it today.

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The Sol-20 expandable system.

**Processor
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HARDWARE REPORT

SUPER CHIP

FD 1771

by Roger Edelson

When we left superchip, the Western Digital FD1771, last month we had just finished describing the input and output signals. Also described were the various subsystem blocks which made up the FD1771's architecture. In this month's column we want to take up the command structure and the status information available from the chip.

Table I, near the end of the article, lists and summarizes the eleven commands which the FD1771 will accept and execute. Commands should only be loaded when the BUSY status bit (Status Bit 0) is off. The one exception is the Force Interrupt command. Whenever a command is being executed, the BUSY status bit is set. When a command is completed, or an error condition exists, an interrupt is generated and the BUSY status bit is reset. The Status Register indicates whether the completed command encountered an error, or was fault free. For ease of discussion, commands are divided into four types as seen in Table 1.

Type I Commands are basically head positioning commands and include the RESTORE, SEEK, STEP, STEP-IN, and STEP-OUT commands. Each of the Type 1 Commands contain a rate field (r_1r_0) which determines the stepping motor rate as defined below:

r_1	r_0	Period (ms)	Rate (sps)
0	0	6	166
0	0	6	166
1	0	8	125
1	1	10	100

The Type 1 Commands contain a head load flag (h) which determines if the head is to be loaded at the beginning of the command or not. If $h = 1$, the head is loaded at the beginning of the command (HLD made

active). If $h = 0$, HLD is made inactive. Once the head is loaded (HLD active), the head will remain engaged until the FD1771 receives a command that specifically disengages the head. If the FD1771 does not receive any commands after two revolutions of the disk, the head will be disengaged (HLD made inactive). The Head Load Timing Input is only sampled after a 10 ms delay, when actual reading or writing on the disk is to occur. Note that a verification, described below, requires reading off the disk.

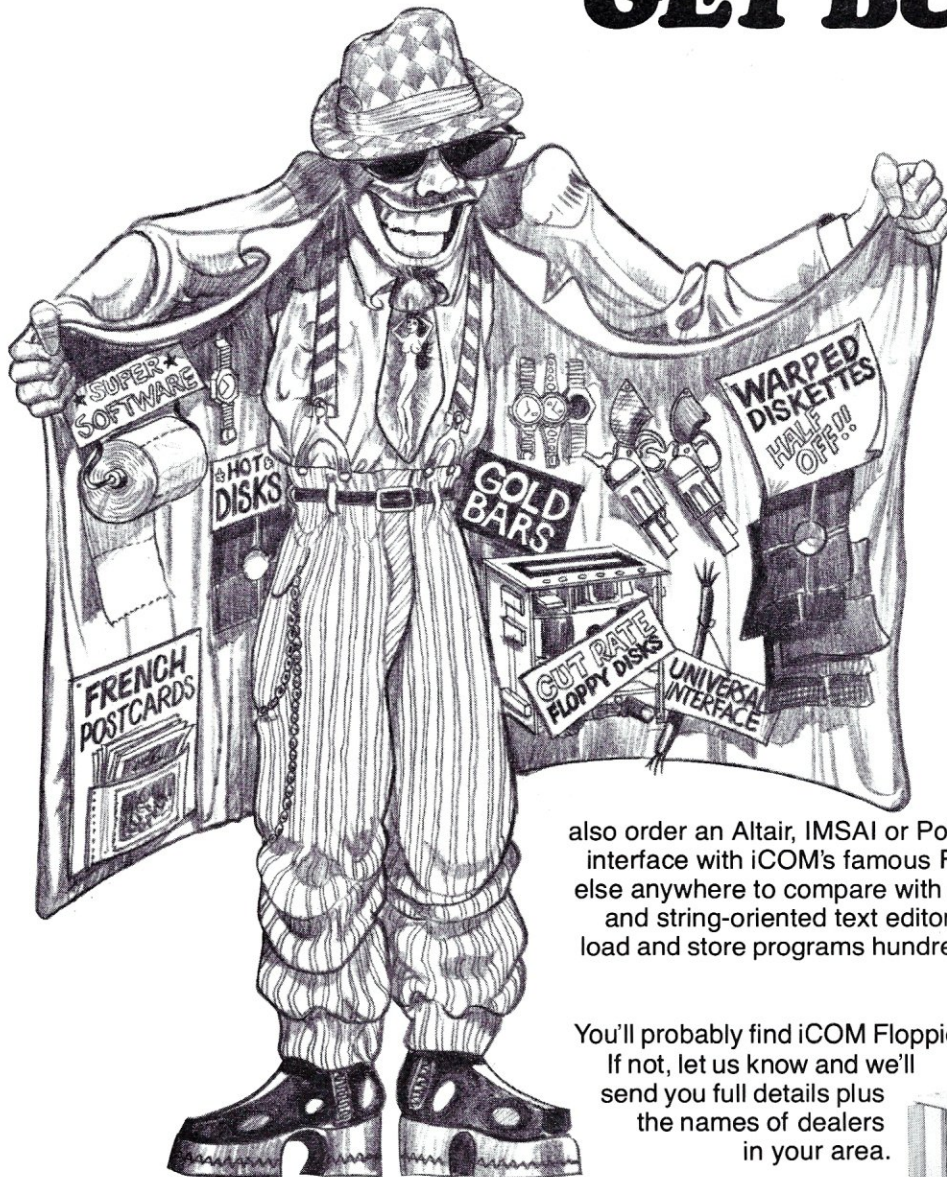
The Type I Commands also contain a verification (V) flag which determines if a verification is to take place on the last track or not. If $V = 0$, no verification is performed. If $V = 1$, a verification is performed.

During verification, the head is loaded (HLD active) and after an internal 10 ms delay, the HLT input is sampled. When HLT is active (logic true), the first encountered ID field is read off the disk. The track address of the ID field is then compared to the Track Register. If there is a match and a valid ID CRC, the verification is complete, and interrupt is generated and the BUSY status bit is reset. If there is not a match and a valid ID CRC, an interrupt is generated, the Seek Error status bit (Status bit 4) and the BUSY status bit is reset. If there is not a valid CRC, the CRC error status bit is set (Status bit 3), and the next encountered ID field is read off the disk for verification. If an ID field with a valid CRC cannot be found after two revolutions of the disk, the FD1771 gives up and interrupts.

The STEP, STEP-IN and STEP-OUT commands contain an UPDATE flag (u). When $U = 1$, the track register is updated by one. When $U = 0$, the track register is not updated.

RESTORE (SEEK TRACK 0) — Upon receipt of this command the Track 00 ($\overline{\text{TROO}}$) input is sampled. If $\overline{\text{TROO}}$ is active low indicating the Read-Write head is positioned over track 0, the Track Register is loaded

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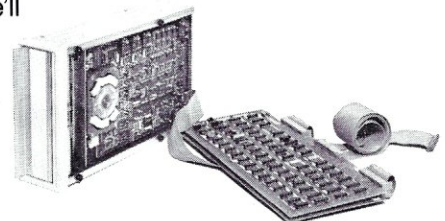
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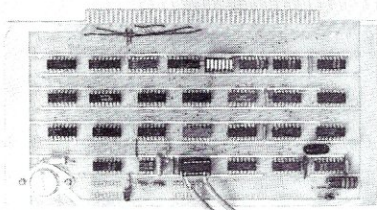
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CIRCLE NO. 11 ON INQUIRY CARD

with zeros and an interrupt is generated. If $\overline{\text{TROO}}$ is not active low, stepping pulses at a rate specified by the r_{10} field are issued until the $\overline{\text{TROO}}$ input is active low. At this time the TR is loaded with zeros and an interrupt is generated. If the $\overline{\text{TROO}}$ input does not go active low after 255 stepping pulses, the FD1771 gives up and interrupts with the Seek error status bit set. Note that the RESTORE command is executed when MR goes from an active to an inactive state.

SEEK — This command assumes that the Track Register contains the track number of the current position of the Read-Write head and the Data Register contains the desired track number. The FD1771 will update the Track register and issue stepping pulses in the appropriate direction until the contents of the Track register are equal to the contents of the data register.

STEP — Upon receipt of this command, the FD1771 issues one stepping pulse to the disk drive. The stepping motor direction does not change. After a delay determined by the r_{10} field, a verification takes place if the V flag is on.

STEP-IN — Upon receipt of this command, the FD1771 issues one stepping pulse in the direction towards track 76.

STEP-OUT — This is the reverse of STEP-IN.

TYPE II COMMANDS

The Type II Commands include the Read Sector(s) and Write Sector(s) commands. Prior to loading the Type II Commands into the COMMAND REGISTER, the computer must load the Sector Register with the desired sector number. Upon receipt of the Type II Commands, the head is loaded (HLD active) and the Busy status bit set. If the E flag = 1 (this is the normal case), HLD is made active and sampled after an internal 10 ms delay. If the E flag = 0, the head is assumed engaged and there is no internal 10 ms delay.

When an ID field is located on the disk, the FD1771 compares the Track Number of the ID field with the Track register. If there is not a match, the next encountered ID field is read and a comparison made. If there is a match, the Sector Number of the ID field is then compared with the Sector Register. If there is not a match, the next encountered ID field is read and a comparison made. If there is a match, the CRC field is read. If there is a CRC error, the CRC error status bit is set and the next ID field is read off the disk and comparisons are made. If the CRC is correct, the data field is located and will be either written or read depending upon command. The FD1771 must find an ID field with a valid Track number, Sector number, and CRC within two revolutions of the disk; otherwise, the Record Not Found status bit is set (Status bit 4) and the command is terminated with an interrupt.

Each of the Type II Commands contain a b flag which in conjunction with the sector length field of the ID field, determines the length (number of characters) of the Data Field.

For IBM 3740 compatibility, the b flag should equal 1.

For b = 1

Sector Length field (hex)	Number of bytes in sector (decimal)
00	128
01	256
02	512
03	1024

IBM 3340
BYTES

GAP	ID AM	TRACK Number	ZEROS	SECTOR Number	SECTOR Length	CRC 1	CRC 2	GAP	DATA AM	DATA FIELD	CRC 1	CRC 2
(33)	1	1	1	1	1	1	1	17	1	128	1	2
ID FIELD								DATA FIELD				

IDAM = ID Address Mark - DATA (FE), CLK (C7)

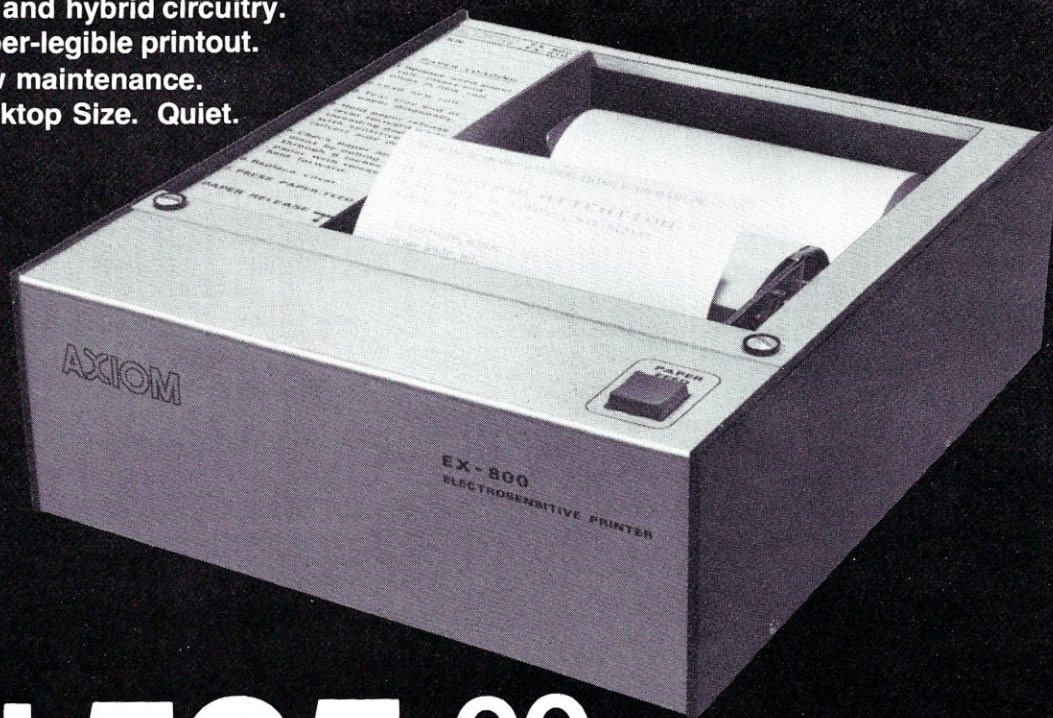
Data AM = Data Address Mark - DATA (F8, F9, FA, or FB), CLK (C7)

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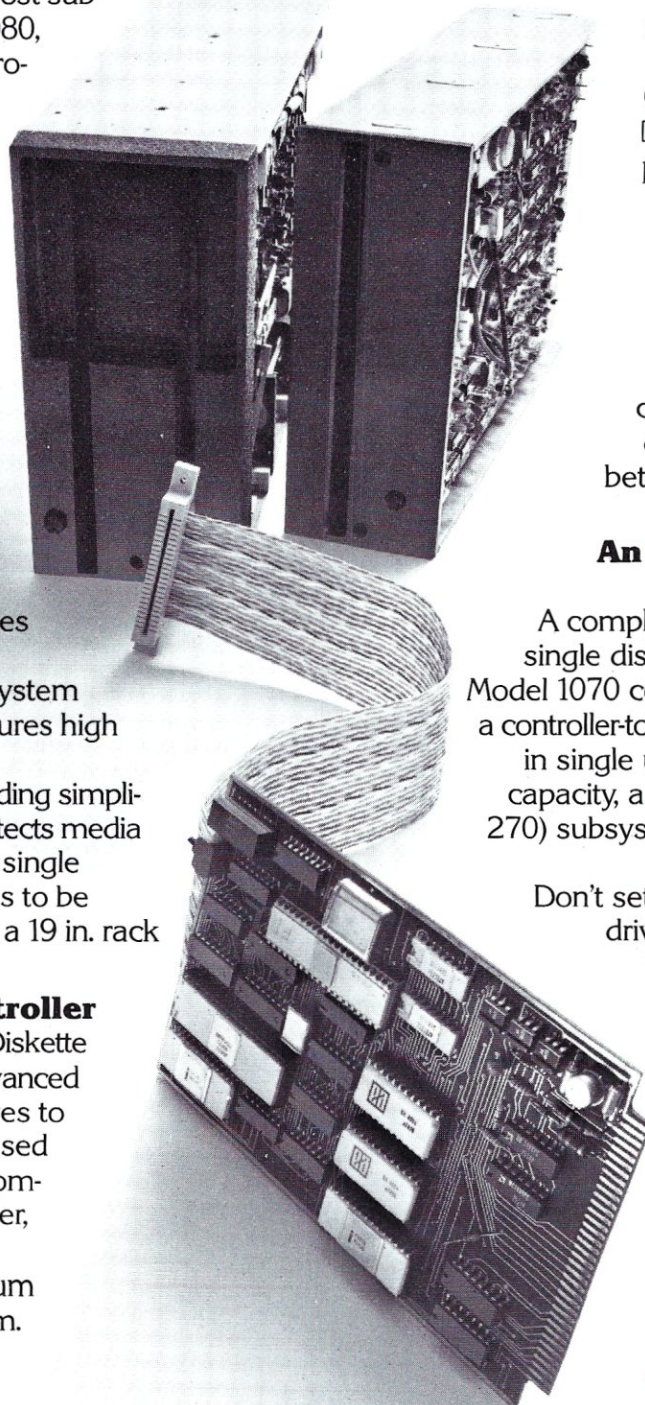
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When the b flag equals zero, the sector length field multiplied by 16 determines the number of bytes in the sector or data field as shown below:

For b = 0

Sector Length field (hex)	Number of bytes in sector (decimal)
01	16
02	32
03	48
04	64
0	0
0	0
0	0
0	0
FF	4080
00	4096

Each of the Type II Commands also contain an m flag which determines if multiple records (sectors) are to be read, or written, depending upon commands. If m = 0, a single sector is read, or written, and an interrupt is generated at the completion of the command. If m = 1, multiple records are read, or written, with the sector register internally updated so that an address verification can occur on the next record. The FD1771 will continue to read or write multiple records and update the sector register until the sector register exceeds the number of sectors on the track or until the Force Interrupt command is loaded into the command register which terminates the command and an interrupt is generated.

READ COMMAND — Upon receipt of this command, the head is loaded, the Busy status bit set, and when an ID field is encountered that has the correct track number, correct sector number, and correct CRC, the data field is then inputted to the computer. The Data Address Mark of the data field must be found within 28 bytes of the correct ID field. If not, the record not found status bit is set and the operation terminated. When the first character or byte of the data field has been shifted through the DSR, it is transferred the DR and a DRQ is generated. When the next byte is accumulated in the DSR, it is transferred to the DR and another DRQ is generated provided that the computer has previously read the DR. If one or more characters are lost, the lost data status bit is set. This sequence continues until the data field has been inputted to the computer. If there is a CRC error in the data field, the CRC error status bit is set, and the command is terminated (even if it is a multiple record command). At the end of the operation, the type of Data Address Mark encountered in the data field is recorded in the Status Register (Bits 5 and 6) as shown below:

Status Bit 5	Status Bit 6	Data AM (HEX)
0	0	FB
0	1	FA
1	0	F9
1	1	F8

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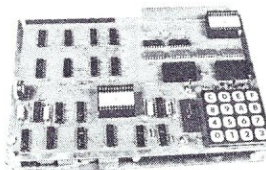
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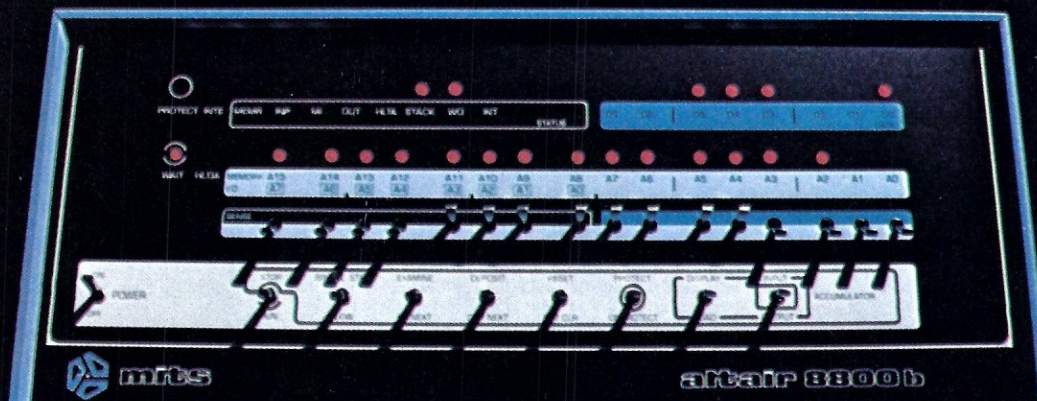
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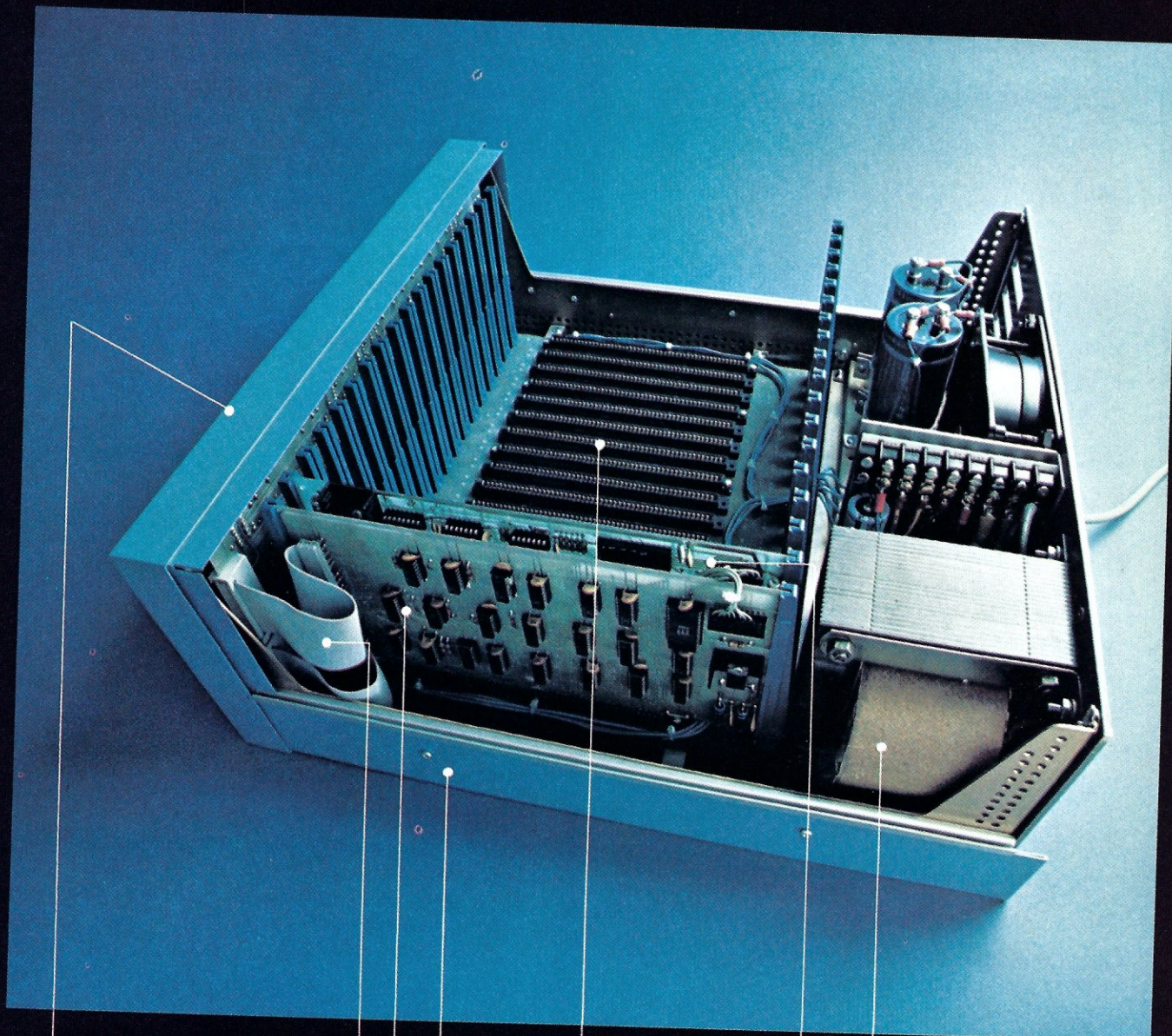
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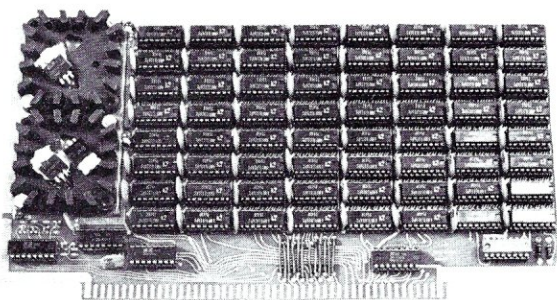
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CIRCLE NO. 18 ON INQUIRY CARD

WRITE COMMAND — Upon receipt of this command, the head is loaded (HLD active) and the BUSY status bit is set. When an ID field is encountered that has the correct track number, correct sector number, and correct CRC, and DRQ is generated. The FD1771 counts off 11 bytes from the CRC field and the Write Gate (WG) output is made active if the DRQ is serviced (i.e. the DR has been loaded by the computer). If DRQ has not been serviced, the command is terminated and the lost Data status bit is set. If the DRQ has been serviced, the WG is made active and six bytes of zeros are then written on the disk. At this time, the Data Address Mark is then written on the disk as determined by the a₁ field of the command as shown below:

a ₁	a ₀	DATA MARK (HEX)	CLOCK MARK (HEX)
0	0	FB	C7
0	1	FA	C7
1	0	F9	C7
1	1	F8	C7

The FD1771 then writes the data field by generating DRQ's to the computer. If the DRQ is not serviced in time, the lost Data Status Bit is set and a byte of zeros is written on the disk. The command is not terminated. After the last data byte has been written on the disk, the two-byte CRC is computed internally and written on the disk followed by one byte of ones. WG is then made inactive.

TYPE III COMMANDS

READ ADDRESS — Upon receipt of this command, the head is loaded and the BUSY status bit is set. The next encountered ID field is then read in off the disk, and the six data bytes of the ID field are assembled and transferred to the DR, and a DRQ is generated for each byte. The six bytes of the ID field are shown below:

TRACK ADDR	ZEROS	SECTOR ADDRESS	SECTOR LENGTH	CRC 1	CRC 2
1	2	3	4	5	6

Although the CRC characters are inputted to the computer, the FD1771 checks for validity and the CRC error status bit is set if there is a CRC error. The Sector Address of the ID field is written into the sector register. At the end of the operation an interrupt is generated and the Busy Status bit is reset.

READ TRACK — Upon receipt of this command, the head is loaded and the BUSY status bit is set. Reading starts with the leading edge of the first encountered index mark and continues until the next index pulse. As each byte is assembled it is transferred to the Data Register and the Data Request is generated for each byte. No CRC checking is performed. Gaps are included in the input data stream. If bit 0 (S) of the command is a 0, the accumulation of bytes is synchronized

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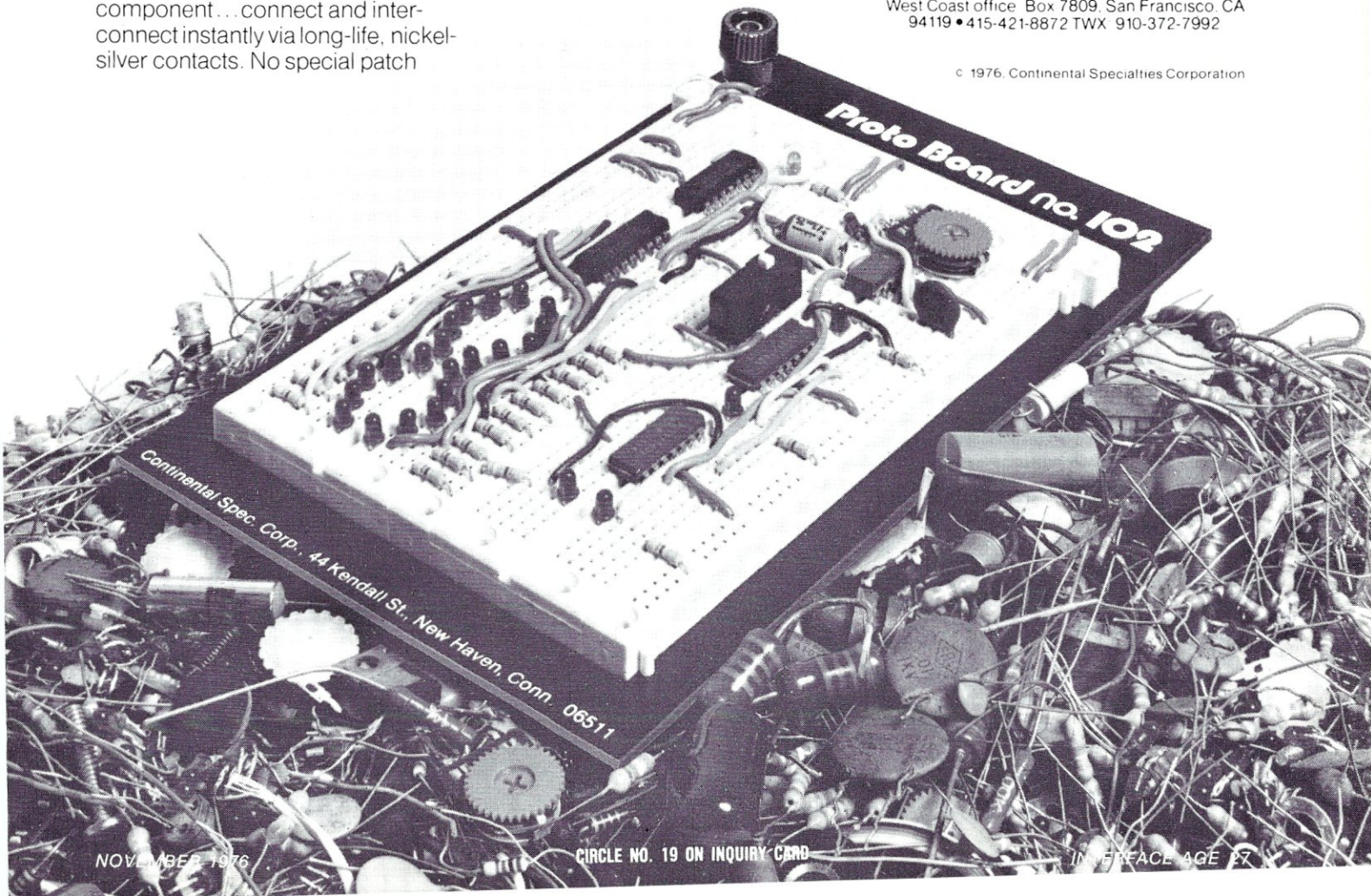
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to each Address Mark encountered. Upon completion of the command, the interrupt is activated.

WRITE TRACK — Upon receipt of this command, the head is loaded and the BUSY status bit is set. Writing starts with the leading edge of the first encountered index pulse and continues until the next index pulse at which time the interrupt is activated. The Data Request is activated immediately upon receiving the command and writing will not start until after the first byte has been loaded into the Data Register. If the DR has not been loaded by the second index pulse the operation is terminated making the device Not Busy, the lost Data Status Bit is set, and the interrupt is activated. If a byte is not present in the DR when needed, a byte of zeros is substituted. Address Marks and CRC characters are written on the disk by detecting certain data byte patterns in the outgoing data stream as shown in the table below. The CRC generator is initialized when any data byte from F8 to FE is about to be transferred from the DR to the DSR.

CONTROL BYTES FOR INITIALIZATION

DATA PATTERN (HEX)	INTERPRETATION	Corresponding CLOCK MARK (HEX) Generated
F7	Write 2 CRC characters	FF
F8	Data Address Mark	C7
F9	Data Address Mark	C7
FA	Data Address Mark	C7
FB	Data Address Mark	C7
FC	Index Address Mark	D7
FD	Spare	
FE	ID Address Mark	C7

The Write Track command will not execute if $\overline{\text{DINT}}$ input is grounded. Instead the Write Protect Status bit is set and the interrupt is activated. Note: One F7 pattern in Data Reg. will generate 2 crc characters.

TYPE IV COMMAND

FORCE INTERRUPT — This command can be loaded into the command register at any time. If there is a current command under execution (Busy Status Bit set), the command will be terminated and an interrupt will be generated when the condition specified in the I_0 through I_3 field is detected. More than one condition may be specified. The interrupt conditions are shown below:

- 10 = Not Ready-To-Ready Transition
- 11 = Ready-To-Ready Transition
- 12 = Every Index Pulse
- 13 = Interrupt occurs within 1 to 10 ms and every 10 ms thereafter.

Commands and types as well as the command flags are summarized in the following four Tables.

COMMAND SUMMARY

TYPE	COMMAND	BITS							
		7	6	5	4	3	2	1	0
I	Restore	0	0	0	0	h	v	r ₁	r ₀
I	Seek	0	0	0	1	h	v	r ₁	r ₀
I	Step	0	0	1	u	h	v	r ₁	r ₀
I	Step In	0	1	0	u	h	v	r ₁	r ₀
I	Step Out	0	1	1	u	h	v	r ₁	r ₀
II	Read Command	1	0	0	m	b	E	0	0
II	Write Command	1	0	1	m	b	E	a ₁	a ₀
III	Read Address	1	1	0	0	0	1	0	0
III	Read Track	1	1	1	0	0	1	0	s
III	Write Track	1	1	1	1	0	1	0	0
IV	Force Interrupt	1	1	0	1	I ₃	I ₂	I ₁	I ₀

COMMAND FLAG SUMMARY

TYPE I
<p><u>h = Head Load flag (Bit 3)</u></p> <p>h=1, Load head at beginning h=0, Do not load head at beginning</p> <p><u>v = Verify flag (Bit 2)</u></p> <p>v=1, Verify on last track v=0, No verify</p> <p><u>r₁r₀ = Stepping motor rate (Bits 1-0)</u></p> <p>r₁r₀=00, 6ms between steps r₁r₀=01, 6ms between steps r₁r₀=10, 8ms between steps r₁r₀=11, 10ms between steps</p> <p><u>u = Update flag (Bit 4)</u></p> <p>u=1, Update Track register u=0, No update</p>

TYPE II
<p><u>m = Multiple Record flag (Bit 4)</u></p> <p>m=0, Single Record m=1, Multiple Records</p> <p><u>b = Block Length flag (Bit 3)</u></p> <p>b=1, IBM format (128 to 1024 bytes) b=0, Non-IBM format (16 to 4096 bytes)</p> <p><u>a₁ a₀ = Data Address Mark (Bits 1-0)</u></p> <p>a₁ a₀=00, FB (Data Mark) a₁ a₀=01, FA (Data Mark) a₁ a₀=10, F9 (Data Mark) a₁ a₀=11, F8 (Data Mark)</p>

TYPE III

s = Synchronize flag (Bit 0)

s=0, Synchronize to AM

s=1, Do Not Synchronize to AM

TYPE IV

li = Interrupt Condition flags (Bits 3-0)

1₀=1, Not Ready to Ready Transition

1₁=1, Ready to Not Ready Transition

1₂=1, Index Pulse

1₃=1, Every 10 ms

E = Enable HLD and 10 msec Delay

E=1, Enable HLD, HLT and 10 msec Delay

E=0, Head is assumed Engaged and there is no 10 msec Delay

Upon receipt of any command, except the Force Interrupt Command, the BUSY Status bit is set and the rest of the status bits are updated or cleared for the new command. If the Force Interrupt Command is received when there is a current command under execution, the BUSY status bit is reset, and the rest of the status bits are not updated nor cleared. If the Force Interrupt Command is received when there is not a current command under execution, the Busy status bit is reset and the rest of the status bits are updated or cleared. In this case, Status reflects the Type 1 commands.

The format of the Status Register is shown below:

7	6	5	4	3	2	1	0	bits
S7	S6	S5	S4	S3	S2	S1	S0	

Status varies according to the type of command executed.

The following Table summarizes the Status Register.

STATUS REGISTER SUMMARY						
BIT	ALL TYPE I COMMANDS	READ ADDRESS	READ	READ TRACK	WRITE	WRITE TRACK
S7	NOT READY	NOT READY	NOT READY	NOT READY	NOT READY	NOT READY
S6	WRITE PROTECT	0	RECORD TYPE (a)	0	WRITE PROTECT	WRITE PROTECT
S5	HEAD ENGAGED	0	RECORD TYPE (a ₁)	0	WRITE FAULT	WRITE FAULT
S4	SEEK ERROR	ID NOT FOUND	RECORD NOT FOUND	0	RECORD NOT FOUND	0
S3	CRC ERROR	CRC ERROR	CRC ERROR	NOT VALID	CRC ERROR	NOT VALID
S2	TRACK 0	LOST DATA	LOST DATA	LOST DATA	LOST DATA	LOST DATA
S1	INDEX	0	0	0	0	0
S0	BUSY	BUSY	BUSY	BUSY	BUSY	BUSY

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169⁹⁵

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RCA ASCII KEYBOARD MODIFICATIONS

by Larry McDavid

INTRODUCTION

An ASCII keyboard built for RCA by George Risk Industries has recently become available on the surplus market at low cost. Due to features inherent in the design, the keyboard configuration is very versatile and may be easily adapted for various systems. This article describes interface circuitry, logic functions, and various custom modifications.

INTERFACE DESCRIPTION

The keyboard, shown in Figure 6, is seven-bit ASCII encoded and includes at least twelve additional keys that may be coded for any eight-bit data byte. The unit is TTL-compatible and operates from 5 Vdc at approximately 350 mA maximum. Both upper and lower case ASCII may be generated, if desired. Since the code is generated by a diode matrix, any key may be easily encoded for any eight-bit data byte. Standard keyboard functions UNSHIFT, SHIFT, and SHIFT LOCK are provided, as is two-key rollover.

The logic devices used are an improved DTL-type, Signetics Utilogic II SP380A quad two-input NOR, as shown in the schematic, Figure 1. These ICs operate at 5 volts and interface directly with TTL. As supplied all keyboard signal outputs are ACTIVE LOW (logical 0 when TRUE), and a KEY DEPRESSED flag (rather than DATA AVAILABLE latch) is used. A simple interface circuit, Figure 2, is required to allow the keyboard to function with a standard parallel input port, such as the Processor Technology 3P + S.

The interface circuit provides an ACTIVE LOW, DATA AVAILABLE latched flag which is reset by an ACTIVE HIGH, ACKNOWLEDGE flag. This logic convention is required by the 3P + S I/O board; unused inverter gates are available in IC 3 if your particular I/O board requires a different logic convention for either flag. This circuitry allows only one character to be output with each keystroke, and maintains the two-key rollover feature.

ICs 2 and 3 invert the eight data bits to provide the standard ACTIVE HIGH data logic signal. The regulator, IC 4, provides 5 Vdc for the keyboard and interface circuitry. The interface circuit and regulator should be located at the keyboard to reduce noise transient problems. At least a ten-foot length of unshielded (twelve conductor) cable has been used successfully. The circuit may be built by standard wire-wrap or prototype board techniques. The regulator should be mounted to a small heatsink. Unregulated 8 volt power may be obtained from the computer I/O board or directly from the motherboard buss.

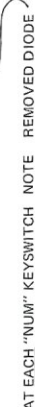
Note that the 3P + S board causes the input DATA AVAILABLE bit in the A-register to go to LOGIC 0 when the keyboard data are ready. This peculiarity of the 3P+S cannot be changed in the keyboard interface. Thus either a CMA instruction must be used before masking with ANI, or the logical sense of the conditional jump instructions must be changed when running programs written for a LOGIC 1 at DATA AVAILABLE. Other parallel input boards may function differently; however, each must be examined individually to establish the software required.

KEYBOARD DESCRIPTION

At least two versions of this keyboard are available. Both employ identical circuit boards but differ in component installation and jumpering. For the purpose of this article, the Version I keyboard is identified by having a "LOCK" key, all gray alphabetic keytops, and no reed relay installed on the lower PC board. Version II has a "NUM" key, approximately fifteen keytops with additional yellow legends, and a reed relay installed.

Many (not all!) Version II keyboards generate both upper and lower case ASCII characters. Since few home computing applications utilize lower case, and to eliminate the need for shifting from upper case to lower case in order to output the 0-9 digits, it is desirable to disable the generation of lower-case characters.

APPROXIMATELY
15 "NUM" KEYSWITCHES
IN "VERSION II"

ANY SILICON
DIODE

INDICATES REMOVED COMPONENT

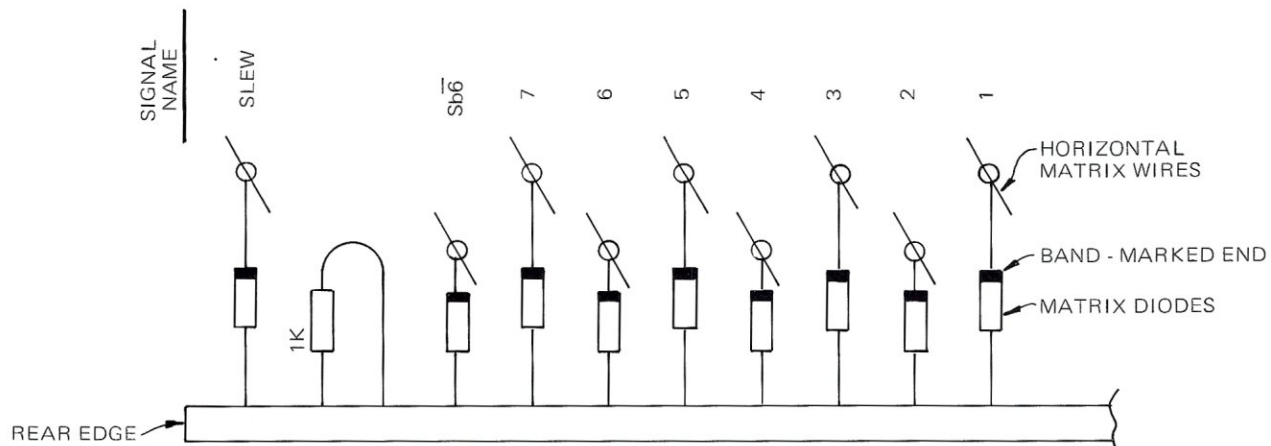


FIGURE 3. PHYSICAL CONFIGURATION OF DIODE MATRIX LOCATED AT REAR EDGE OF UPPER CIRCUIT BOARD. DIODES SHOWN INSTALLED AT ALL MATRIX LOCATIONS. VIEWED FROM LEFT SIDE OF KEYBOARD

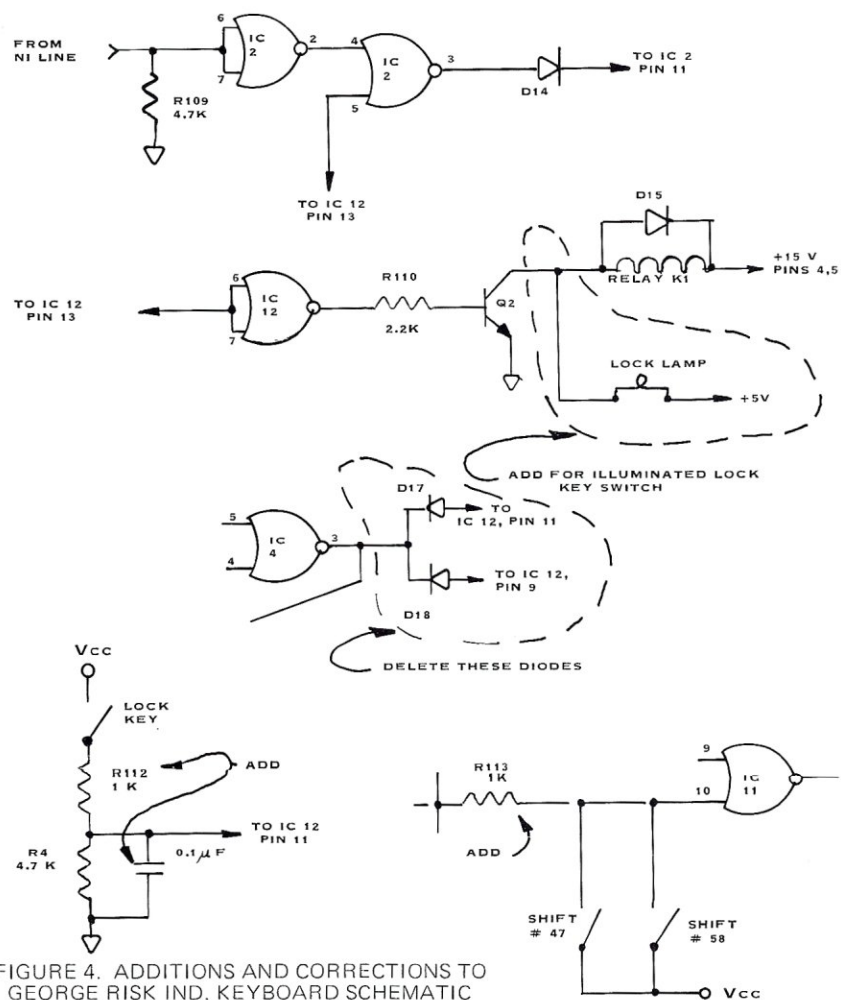


FIGURE 4. ADDITIONS AND CORRECTIONS TO GEORGE RISK IND. KEYBOARD SCHEMATIC

NOTE: FIG. 4 & 5 INDICATE CHANGES TO THE SCHEMATIC FURNISHED WITH MANY KEYBOARDS. THESE CHANGES ARE ALREADY REFLECTED IN THE NEW KEYBOARD SCHEMATIC FIG. 1

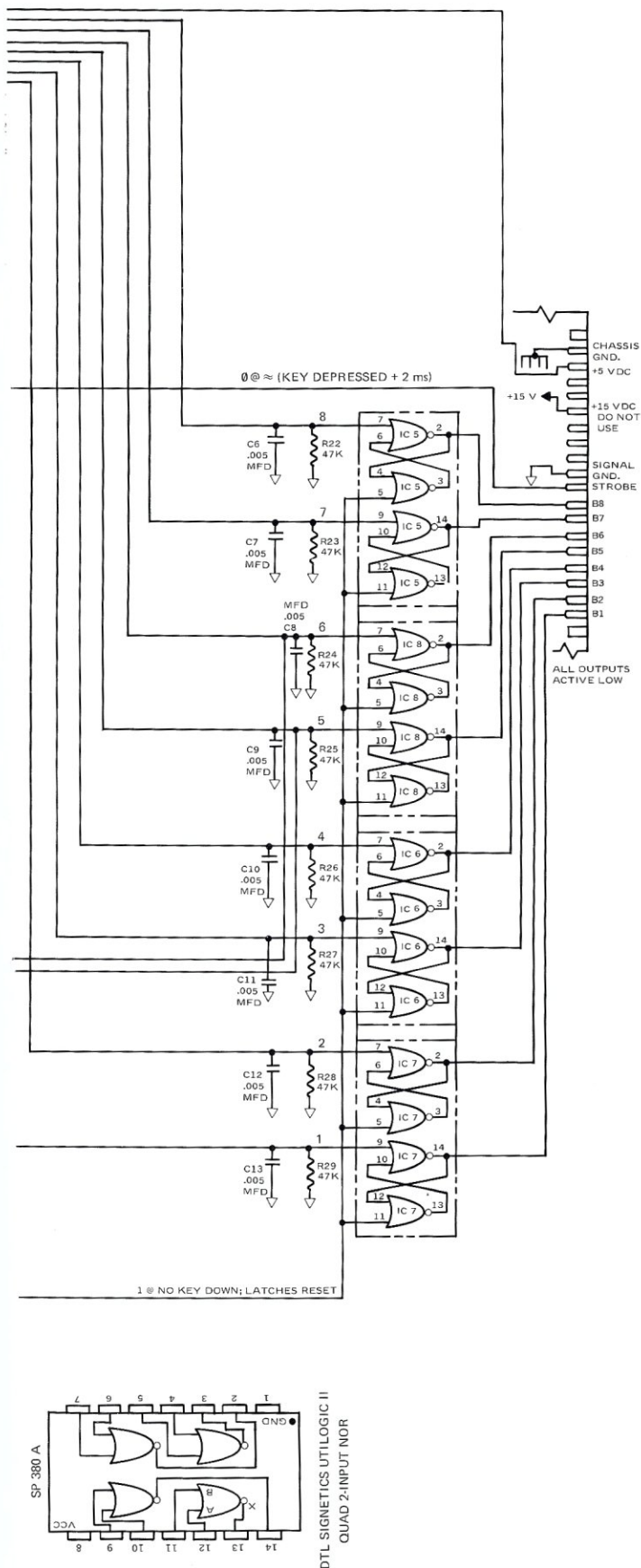


FIGURE 1. Keyboard Schematic. Shown with corrections and with the diode matrix modified for special character generation as discussed in the text.

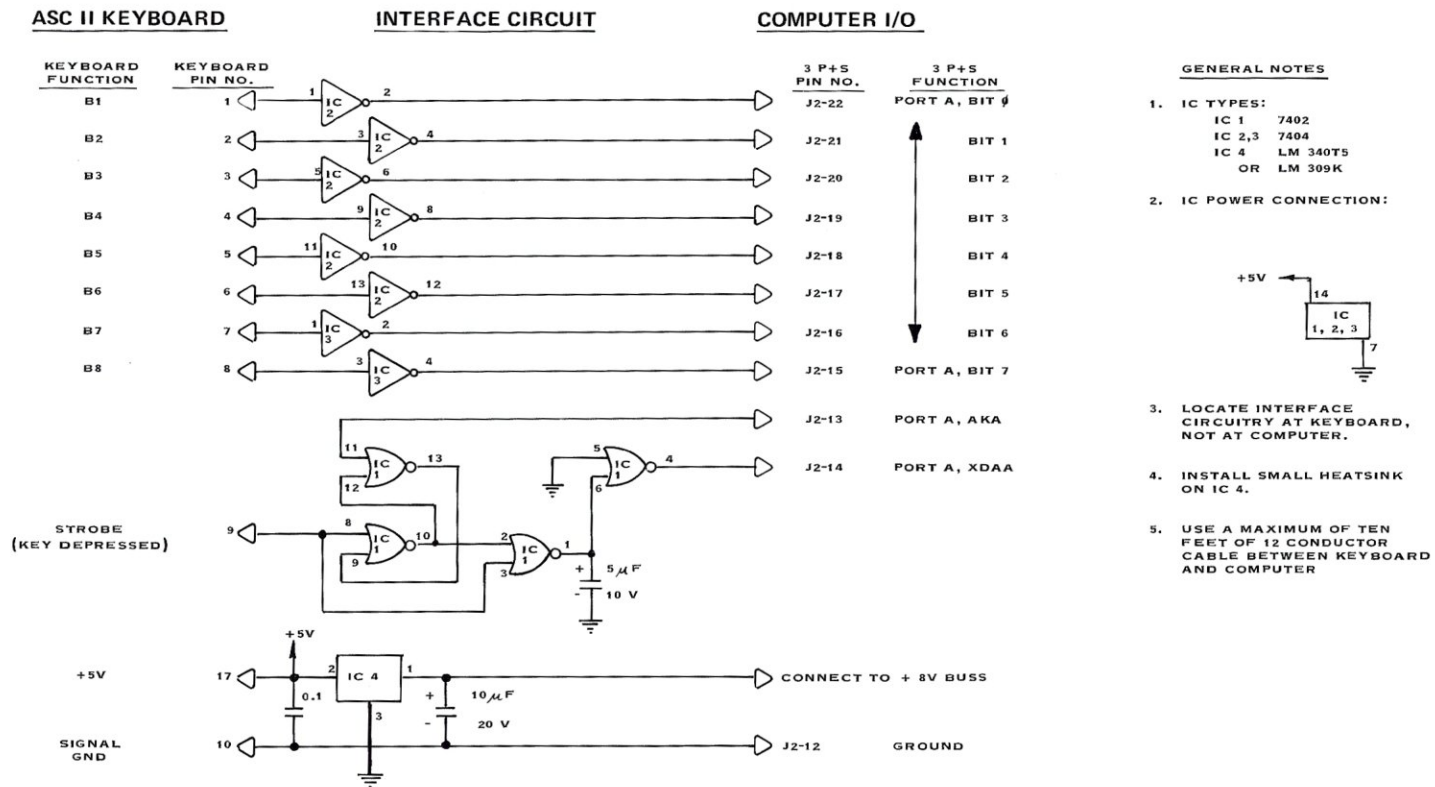


FIGURE 2. KEYBOARD INTERFACE SCHEMATIC

Version I is, therefore, preferred, since less conversion is required and since all keytops are of uniform color. Either version, however, may be easily modified to provide lower case as described subsequently.

Figure 3 shows that portion of the diode matrix located along the rear edge of the upper circuit board. Data bits 1, 2, 3, 4, 5, 6, and 7, and signals Sb6 (shift-bit 6 NOT) and SLEW (used to determine when more than one key is depressed) are located here. At the right edge of this matrix are seven diodes connected to data bits 1-7; these diodes generate the signal "OR," which initiates a KEY-DEPRESSED flag from the keyboard logic. Note that unless one of the data bits 1-7 is ACTIVE, no KEY-DEPRESSED flag is generated.

Additional elements of the diode matrix are located along the front edge of this board: data bit 8, Sb5 (shift-bit 5 NOT), Sb6 (shift-bit 6), Sb5 (shift-bit 5), SLBI (shift-lock bit inhibit), and NI (NUM inhibit). The nomenclature for these signals is etched on the upper circuit board near the wires connecting the two boards; some etching, particularly the NOT operators, is indistinct and care must be taken when tracing circuitry. Referring to the schematic, Figure 1, and to Figure 3 will help to identify each signal.

Now that the various signals required by the keyboard logic have been named and identified, some simple rules can be established to explain their function:

- (1) Diodes in data bits 1-8 cause that bit to go ACTIVE.
- (2) Diodes on signal line Sb6 enable lower-case ASCII characters when in UNSHIFT mode.
- (3) Diodes on signal line SLBI cause the character code generated when in SHIFT-LOCK (NUM) mode to revert to the UNSHIFT mode character code.
- (4) When in the UNSHIFT mode, diodes on signal lines Sb5 and Sb6 cause data bits 5 and 6 to go ACTIVE; these diodes have no effect when in the SHIFT mode.
- (5) When in the SHIFT or SHIFT-LOCK (NUM) mode, diodes on signal lines Sb5 and Sb6 cause data bits 5 and 6 to go ACTIVE; these diodes have no effect when in the UNSHIFT mode.
- (6) Diodes on signal line NI suppress generation of the KEY-DEPRESSED flag when in the SHIFT-LOCK (NUM) mode; these diodes have no effect when in the UNSHIFT or SHIFT mode. This feature is used only on Version II keyboards.

Version II keyboards employ fifteen dual-function (DPST or two Form-A contacts) keyswitches; these keyswitches may be identified as those with four wires rather than two. These keys provide an additional set of digits 0-9 and certain other functions when enabled by the "NUM" key; further, the KEY-DEPRESSED flag from non-NUM keys is inhibited. This feature allowed the keyboard to be used for five-finger numeric entry. The additional circuitry employed for the "NUM" feature is shown in Figures 4 and 5; this circuitry is not shown on the schematic furnished with most keyboards. Since all PC boards are identical, this circuitry is present in all keyboards, but many components are deleted or not

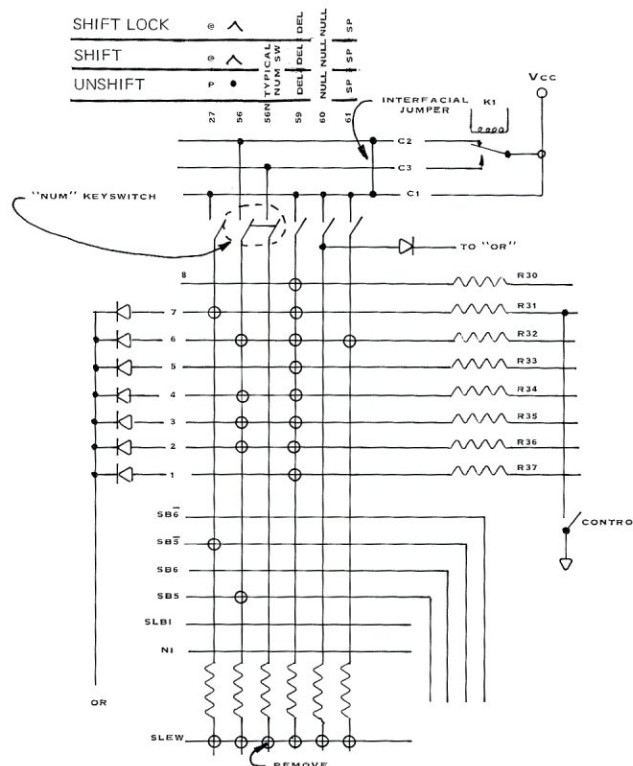


FIGURE 5. MATRIX CODING AFTER MODIFICATION
(TYPICAL KEYSWITCH FUNCTIONS SHOWN)

connected for the simpler Version I design.

KEYBOARD LOGIC MODIFICATION

Now that all keyboard logic functions are known, modifications to customize the unit for a particular system can be started. If a Version II keyboard is to be used, the "NUM" feature must be disabled. To defeat this circuitry while retaining the customary "SHIFT-LOCK" function, remove all diodes from the NI line, remove all "N"-marked diodes from the SLEW line, remove diode D14 from the lower PC board, and remove relay K1. Install an interfacial (front-to-back) jumper through the hole near wire C1 on the right edge of the upper PC board; simply solder the jumper to both sides of the board at the hole. Removal of all other diodes from the "N"-marked switch lines at both the front- and rear-edge matrices is suggested, but not essential. The "NUM" key will now perform the usual "SHIFT-LOCK" function, and the yellow-legend characters will be suppressed.

The lower-case ASCII character set may be disabled, if present, by removing twenty-six diodes from the Sb6 signal line. There are twenty-eight diodes on this line: twenty-six for the alphabetic characters and two at keyswitches 29 and 30. Use of these two diodes is dependent on the desired coding for these two special function keyswitches, as described subsequently. With the twenty-six diodes removed, upper-case ASCII characters are generated in UNSHIFT, SHIFT, and SHIFT-LOCK modes. Alternatively, lower-case characters may be added simply by adding twenty-six diodes to the Sb6 line; install these diodes with the same polarity as the other diodes in the matrix. With the diodes installed, lower-case characters are generated

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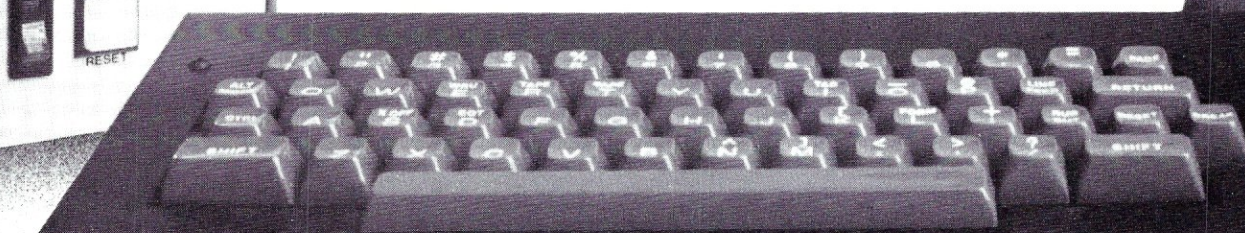
Routines in the 1024 byte monitor display the contents of each of the 8080 internal registers, and the value in memory that is addressed by each register pair. Programs may be executed one instruction at a time. Data at any location in memory can be displayed and may be easily altered. All front panel data is entered in hexadecimal notation for operator convenience.

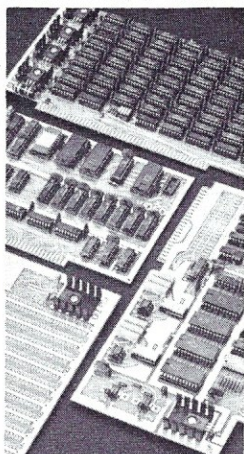
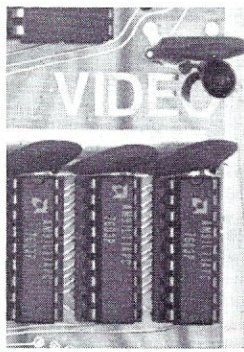
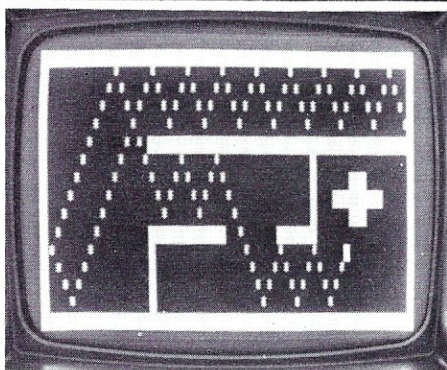
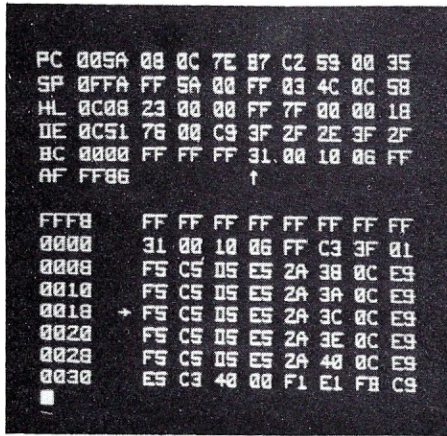
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System 3 kit includes System 2 plus 8K of RAM with BASIC and assembler programs on cassette tape. \$990.

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in the UNSHIFT mode; upper-case characters are generated in the SHIFT and SHIFT-LOCK modes.

The lower-case ASCII character set may also be enabled or disabled by the use of a small SPST toggle switch if desired. To do this, break the Sb6 line by cutting the wire between the upper and lower PC boards; install the switch in series with this wire. The twenty-six diodes must also be installed. With the switch ON, lower-case characters will be generated as described previously. With the switch OFF, only upper-case characters will be generated. Note, however, that the Sb6 diodes on keyswitches 29 and 30 will have no effect with the switch OFF. The advantage of switch-selectable lower-case ASCII offsets this limitation on special coding of these two keyswitches.

Several other modifications should be considered to improve performance. The 470 pF capacitor C1 establishes the timing for the POR (power-on reset) into the UNSHIFT mode. This capacitor is too small for the typical slow-rising power supply and should be replaced with a 0.1 microfarad or larger capacitor. Occasionally, noise spikes may cause the keyboard to enter the "SHIFT-LOCK" mode. This may be prevented by adding a 0.1 microfarad disc across R4; be certain, however, that R112 (1K), rather than a jumper, is installed. Check also to see that a 1K resistor is installed at R113; if a jumper is present, remove and replace it with the resistor. Diodes D17 and D18 appear to be a design afterthought of questionable value; if present, they should be removed.

The reed relay driver, Q2, functions well as a driver for a lamp that indicates the keyboard is in the SHIFT-LOCK mode. This lamp may be either a standard illuminated keyswitch or an external 5-volt lamp. Verify that resistor R110 (2.2K) and Q2 (any NPN transistor) are installed. Carefully observe the pinout configuration of Q2, and connect as shown in Figure 4.

DIODE MATRIX MODIFICATION

Since a diode matrix is employed to generate the various character codes, changing the code generated by a particular keyswitch requires changing only the matrix diodes associated with that switch. Thus, any keyswitch may be coded to generate virtually any 8-bit data byte; further, the data byte may be altered between UNSHIFT, SHIFT, and SHIFT-LOCK modes. This fact results in the unique flexibility of this keyboard and the usefulness to the computer hobbyist.

Implementation of a CONTROL function keyswitch is easily accomplished; either a new switch may be added or an existing keyswitch used. If an existing keyswitch is used, such as the "1" symbol at switch 1, cut both traces to the switch terminals; route two wires from the switch terminals across the upper board and down to the lower board. Connect one wire to the end of R31 near the "R31" designator; connect the other wire to any signal ground, such as the one at pin 1 of IC4. This modification will cause bit 7 to go INACTIVE when the CONTROL switch is depressed, regardless of the SHIFT mode. Note, however, that nonalphabetic CONTROL characters are not suppressed.

A few examples will clarify the versatility of the diode matrix coding. If lower-case characters are disabled, it is then possible and desirable to implement certain SHIFT alphabetic characters, such as SHIFT-N (ASCII "↑"), used for exponentiation in BASIC, and SHIFT-P (ASCII "@"). Consider SHIFT-N first:

8	7	6	5	4	3	2	1	Output Data Bit
φ	1	φ	φ	1	1	1	φ	"N" (Hex 4E); UNSHIFT mode
φ	1	φ	1	1	1	1	φ	"↑" (Hex 5E); SHIFT mode

Note that only bit-5 differs: a logical 1 is required in the SHIFT mode. From Rule (5), add a diode to the Sb5 signal line at keyswitch 53 ("N"). Now, when in the UNSHIFT mode, "N" (Hex 4E) is generated; bit-5 goes ACTIVE when in SHIFT or SHIFT-LOCK mode in order to generate "↑" (Hex 5E).

Now consider SHIFT-P:

8	7	6	5	4	3	2	1	Output Data Bit
φ	1	φ	1	φ	φ	φ	φ	"P" (Hex 50); UNSHIFT mode
φ	1	φ	φ	φ	φ	φ	φ	"@" (Hex 40); SHIFT mode

Note that again only bit-5 differs; a logical 1 is required in the UNSHIFT mode. Unlike the previous example, however, there is no single-diode change that can provide the desired result, since data bit-5 in this case is generated by the matrix along the rear edge of the upper PC board and is unaffected by the keyboard SHIFT mode. It is, therefore, first necessary to remove the diode from the bit-5 line in order to allow bit-5 to be controlled by the variable bit-5 lines, Sb5 and Sb5. From Rule (4), add a diode to the Sb5 signal line at keyswitch 27 ("P"). Now, when in the UNSHIFT mode, "P" (Hex 50) is generated; bit-5 is now ACTIVE only in the UNSHIFT mode, allowing the generation of "@" (Hex 40) in SHIFT or SHIFT-LOCK. Note that diodes may not be installed in both the data-bit and shift-bit lines for bit-5 and bit-6.

The last example cited combines two existing key functions ("P" and "@") into a single keyswitch, thereby allowing the matrix for the duplicated switch to be recoded for an additional special function. Frequently-used control functions, such as CTL-X, cursor control codes, ASCII "←" (Hex 5F), etc., may then be coded at other keyswitches. A good example of a character where the code must not change with the SHIFT mode is ASCII "←" (Hex 5F):

8	7	6	5	4	3	2	1	Output Data Bit
φ	1	φ	1	1	1	1	1	"←" (Hex 5F); all modes

Since no SHIFT change in the generated code is desired, all diodes on the Sb6, Sb5, Sb6, Sb5, and SLBI must be removed. Add diodes as required to the

selected keyswitch line at data bits 1, 2, 3, 4, 5, and 7.

Some applications require a NULL or BLANK (Hex 00) code. This may be implemented by removing all diodes (except SLEW) from one keyswitch line. Since the existing "OR" signal line initiates a KEY-DEPRESSED flag only if at least one data bit is ACTIVE, the flag must be initiated in another manner. To accomplish this, add a diode from the keyswitch line directly to the "OR" signal line. If keyswitch 60 is modified for the NULL function, the diode to be added may be easily tack-soldered under the board since the "OR" line is nearby. Carefully observe the polarity of this diode and wire as shown in Figure 1.

When adding diodes to the rear-edge matrix, drill a hole under the appropriate signal line using a number 73 or 60 drill. Drill from the underside of the board and locate the hole tangent to the edge of the keyswitch line etched trace. Insert the diode from the top, bend the lead down against the trace, and tack-solder.

Although the keyboard modifications described here may seem tedious, they are straightforward and the effort is well justified, as a very versatile keyboard results. At least twelve keys are available for encoding with special functions. My own system, shown as-modified in Figure 1, includes "ESCAPE," "LINE FEED," "CANCEL," "DELETE," "NULL," and cursor controls "UP," "DOWN," "RIGHT," "LEFT," "HOME," and "CLEAR."

INTERFACING WITH THE 3P + S

The modified keyboard is easily interfaced with the 3P + S I/O board. Pin numbers and signal names for the 3P + S are shown on the interface schematic, Figure 2. It is assumed that Port A is to be used for keyboard data and that bit-2 of status Port C is to be used for the DATA AVAILABLE flag.

Typical jumper installation on the 3P + S for a small system is given below. It is assumed that the keyboard is the only I/O device driven by the 3P + S:

Area A "A2" to "GND" Establishes 00H as the board
"A3" to "GND" address
"A4" to "GND"
"A5" to "GND"
"A6" to "GND"
"A7" to "GND"

Area B "L" to "R" Establishes relative address sequence: C, D, A, B. Thus the status (Port C) is at address 00H and the keyboard data (Port A) at address 02H.

Area C "C" to "R" Disables software control of the UART status register.

Area D "C" to "R" Disables TTY current loop transmitter

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Area E

It is suggested that AREA E jumpers be configured for a 110-baud teleprinter, even if one is not in use. These terminals should not be left floating (unconnected). For 110 baud, install the following jumpers:

1010 0001 1101 Binary Code
VGVG GGVV VGVV Jumper
to this terminal row

Area F

No resistor installation required.

Area G "FA" to "C2"

Establishes bit-2 of Port C as the keyboard DATA AVAILABLE flag.

Area H

No jumpers required.

Area J

No jumpers required.

The above jumper installation assumes the simplest possible I/O configuration. If other devices are to be used, additional jumpers may be required.

MIT'S BASIC AND THE 3P + S

The difficulty in interfacing a parallel ASCII keyboard with MIT'S BASIC is a common problem faced by 3P + S owners. MIT'S BASIC requires that the input status flag be at PORT 0 and input data at PORT 1. Without

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The prices listed above are exclusively for hobbyist user's of TDL's ZPU in hobby applications. Non-ZPU users and commercial applications carry a price of \$150 per program. All TDL software is written for the Z80 and is relocatable. Soon to-be-released packages include FORTRAN IV with hardware multiply/divide, an excellent DOS, and Disc Basic.

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Text Editor - \$15

The Zapple Text Editor occupies only 3½K of core and offers full manipulation of characters, lines, or blocks of text. Features include insertions, deletions, searches, additions and much more. It is recommended for use with our assembler - as well as the starting point for any word-processing system. DELIVERY: From Stock

modification to the 3P + S, there is no way to accomplish this due to the limitation to port sequences of ABCD or CDAB. As designed, port C is used for status flags and either port A or B for parallel data. Status and data at PORT 0 and 1, respectively, can be obtained, however, by using port A as the status port. Select the ABCD port sequence by installing a jumper from "L" to "C" in Area B. Connect the keyboard data to port B (note that the interface schematic, Figure 2, reflects port A for keyboard data). Install a jumper on the 3P + S board from "FB" to bit 0 of input port A. A convenient point for this connection is the plated-through hole immediately below J2. This modification to the 3P + S does, however, require that both available parallel ports be used for the keyboard. With all sense switches down, MITS BASIC will now input normally from the keyboard. Note that no provision is made for output from BASIC via the modified 3P + S board; output is normally provided by a video interface, such as the Processor Technology VDM-1.

KEYBOARD REPLACEMENT PARTS

Although the keyboard as a whole is no longer in production, parts such as keyswitches and keytops are still standard catalog items with the manufacturer, George Risk Industries. Special keytops engraved with any desired legend, and in a variety of colors, may be purchased; setup charges and minimum order costs are nominal. A catalog describing the reed pushbutton switches and keytops (Bulletin S-13) may be obtained from the manufacturer at G.R.I. Plaza, Kimball, Nebraska 69145. The following part numbers are of interest:

- KB-01-01-FL Standard keyswitch, less keytop (specify for use with style J keytop)
- KB-01-5.0-03-FL Illuminated keyswitch with 5-volt lamp and strong spring, less keytop (specify for use with style J keytop)

The standard gray keytop is described as follows: cap style J, color 14, character height 0.135. Up to two lines of four characters each may be engraved. For additional information, refer to Bulletin S-13.

The Signetic Utilogic II ICs (SP380A) are available at LMN Electronics, 1042 East Garvey Avenue, West Covina, California 91790, (213) 967-4611. Other surplus outlets may carry them in stock also. Further, the National DM8836 is a direct replacement.

ADDITIONAL NOTES ON INTERFACE CONSTRUCTION

No printed circuit board for the interface circuit shown in Figure 2 is available. It is suggested that the circuit be built on a piece of epoxy-glass prototype board with holes located at 0.10-inch centers; Vector board 64P44-062 is adequate. Size the board by laying out all the components, including cable terminals, and allowing perimeter space for support bolts.

Use wire-wrap sockets for the ICs. Push the sockets through the board and cut the pins to allow 1/4-inch



FIGURE 6. RCA keyboard shown in its cabinet. Note the added keyswitches and new legends on the keytops.

protrusion. Bend several pins outward to hold the socket in place. Install Vector T42-1 terminals for all wires to the keyboard and computer; push these terminals through from the same side as the IC sockets. Also install terminals for the capacitors and the regulator, IC 4.

Mount the regulator, IC 4, to the board using standard hardware. Use a heatsink or small piece of sheet aluminum bent into a "U" between the IC and the board.

Wire the circuit on the back side using 24 to 28 gauge solid buss wire and insulating sleeving. Wire placement is not critical; leave excess wire between all connections to prevent physical stress on the solder joints.

Connect the interface board to the keyboard and computer using stranded 22 or 24 gauge wire. Round 12-conductor cable with a vinyl jacket is available at electronic part stores or stores selling intercoms. Multiple-pin connectors, such as the standard 25-pin rear panel connector, may be used if desired.

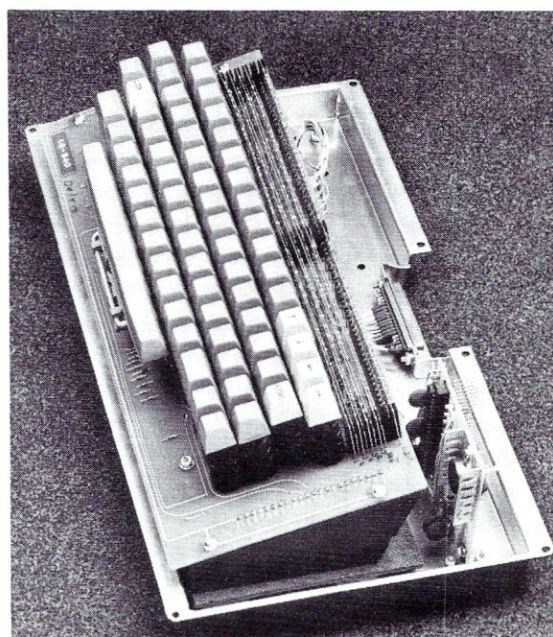
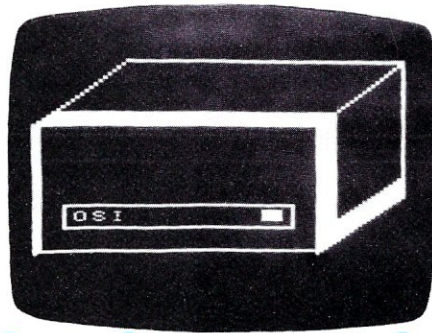


FIGURE 7. Keyboard with cover removed showing interface circuit built on vector board.

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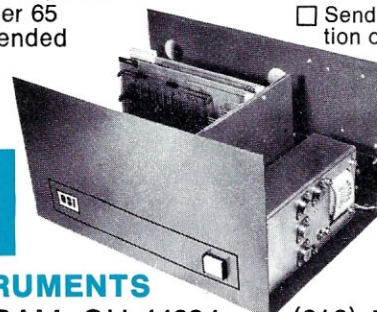
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PROTECTING STORED PROGRAMS

by William Sevedge, Jr.

In the computer industry, safeguarding stored programs is a major concern. Texts, Brochures, and company documents stress the need for firm guidelines. The reason for such guidelines is that not only are the safeguards necessary to protect the programs, but also to maximize the life of the storage device. In business, if a program is lost due to poor safeguards, it could result in the total collapse of the company.

Many large businesses have separate areas where their data processing is accomplished. These rooms are immensely clean. The atmospheric pressure is regulated to keep out dust by having approximately 5psi more than the connecting room pressure. Temperature and humidity are kept within 5%, with the operating temperature in the low 70s'. Further it is noticed that several organizations keep the temperature of the tape storage library two to four degrees cooler than the processing room. Floors are not waxed because ordinary foot traffic will wear the wax away causing dust which will contaminate the storage files. Food and drink, as well as smoking are prohibited. With these types of restrictions, you can see that the computer industries emphasis on program storage that they are encountering in this modern era.

WHAT ABOUT THE HOBBYIST?

The hobbyist cannot be expected to maintain the rigid standards found in the computer industry, but there are safeguards that can be followed to assure maximum use and protection. To many of you, this article may bring a smile, considering it is common sense, but to those who may be unaware of the pitfalls of preserving software, the following text might save you valuable time and perhaps money. The hobbyist can generally store their programs in several different ways, most generally on paper tape, cassette, and floppy disk. Some paper tape manufacturers offer an oil soaked paper tape. This is to give longer life before the paper becomes brittle. If your stored programs

are punched on this type of tape, the oil will eventually seep out. This usually takes about one to two years. To be general, paper tape offers the least amount of long term storage protection, therefore should be used for short duration storage. If this is your only method of program storage consider these tips to preserve your tapes. If the programs are used regularly, they will wear out, and become soft, the feed holes (if used with your tape reader) will elongate, causing loss of data. Duplicate these tapes often. If the tape is used sparingly, keep in an airtight container, such as plastic freezer storage containers. Keep in a cool place, away from bright light. DO NOT use rubber bands to keep the tapes from unraveling, for the rubber will deteriorate and appear to be 'melting' (due to ozone). This will leave a gummy residue on the tape, difficult to remove. Do not overtighten wound rolls of tape. Keep only enough pressure on the roll to prevent the center from falling out. Duplicate unused tapes once every six months to assure a good copy.

CAUTION:

WHEN DUPLICATING TAPES, MAKE SURE THAT YOU GET A GOOD COPY BEFORE DISCARDING THE ORIGINAL TAPE. PREFERABLY, RUN THE PROGRAM, DO NOT RELY ON CHECKSUM VALUES.

MAGNETIC TAPES

Magnetic tapes in the form of cassette are far more reliable than paper tape for long term program storage. Mainly because the data will not change or fade with age, but remains unchanged until altered by a magnetic field. Although a good quality recorder will assist in maximizing its life by proper speed control, tape tension, and wear. Most cassette failures are caused by poor handling. Worth watching for: Keep recorded cassettes away from any magnetic or electro-magnetic devices. Stray magnetic fields from electric typewriters, tape winders, electric erasers, or home vacuum cleaners may be enough to alter or even destroy your stored programs. Keep all stored programs off

the top of your equipment, especially those which have cooling fans. Keep your hands off of the tape surface, as skin oils will eventually affect the tape quality. Food and drink should not be consumed where there are exposed programs. Accidents DO happen. Keep tapes in air tight containers, as mentioned for paper tape, because dust on the surface of the tape will wear down the oxide surface. If the tapes are not used frequently, keep a tab on the cover to remind you to wind and rewind your tapes periodically to prevent sticking when ready to load the computer.

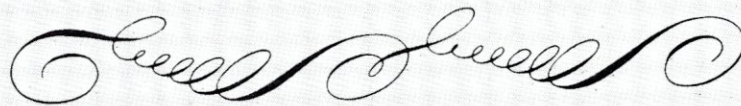
FLOPPY DISK STORAGE

Floppy disk program storage works by magnetic impulses as does cassette. But, unlike cassette, the disk packages are more likely to be abused by improper handling. Tossing a floppy disk to a nearby table after its been removed from the drive mechanism should not be tolerated (don't smile, I've seen it done). Since the average disk is a cardboard covered disk with exposed surfaces for the heads, scratches are imminent. These scratches will remove the oxides from the disk and may prevent a good load. By not properly packaging the floppy disk after use, and leaving it in the drive is an invitation for dust to settle on the surface. Dust as mentioned before will cause minute scratches on the surface of the disk causing a diminution of its maximum life. Further protection of floppy disks will follow the same rules applied for the cassette.

Attempt to operate as a professional organization would. Be strict with yourself and friends when handling your software. A case in point: A major manufacturing organization lost valuable software because the janitorial service cleaned the tape storage area with an upright vacuum cleaner instead of using the wall mounted system. This action was not isolated until considerable damage was incurred.

Whatever type of program storage you are using, make it a point to have a hard copy listing on file, so that in case of an accidental erasure or alteration, you may be able to salvage whats left, and reload the programs. Software is expensive in time and money. By not observing firm guidelines you may lose the program.

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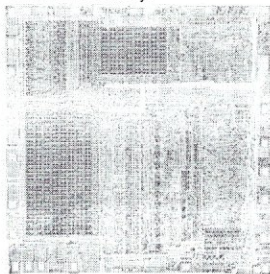
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PERIPHERALS	58	377
PAPER TAPE EQUIPMENT	63	378
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MEMORY CARDS	77	382
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MICROPROCESSORS

Electronic Arrays Introduces the 9002

Electronic Arrays has introduced the EA 9002, an 8 bit microprocessor. A 28 lead +5 volt device, contains an on-board 64 byte R/W RAM, 8 general purpose registers (12 BIT), a seven level subroutine stack (12 BIT), and directly addresses up to 4K words of external memory.



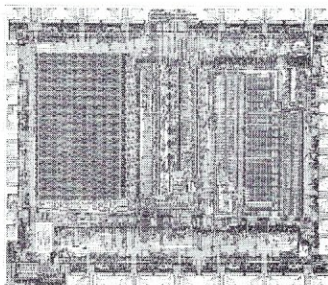
The 8 bit ALU will ADD and SUBTRACT both binary or BCD numbers without need for any software correction. The 55 instructions include a complete set of both arithmetic and logical instructions.

For further information contact Richard M. Eiler, Marketing Manager Advanced Products, 550 E. Middlefield Rd., Mountain View, CA 94043.

CIRCLE INQUIRY NO. 70

Rockwell Announces Two New 8-bit Microprocessors

Designated the PPS—8/2 family, both systems provide two-chip microcomputers with CPU, one automatic serial and 16 parallel I/O ports, 16-bit interval timer, three-level interrupt, clock circuit, 64 x 8 RAM and either 1024 x 8 or 2048 x 8 ROM. Both use 109 instructions.



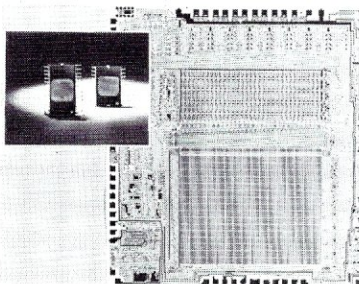
The 1K ROM two-chip microcomputer is priced under \$25 for the two devices in 1,000 quantities, while the 2K ROM two-chip microcomputer is under \$30.

For further information contact Rockwell International, Microelectronic Device Division, 3310 Miraloma Ave., P.O. Box 3669, Anaheim, CA 92803, Telex Via TWX 910-591-1654.

CIRCLE INQUIRY NO. 71

The F-8 By Fairchild

The heart of Fairchild's F8 microprocessor is this central processing unit circuit (CPU), designated the 3850.



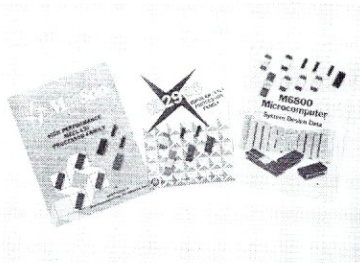
This high-density N-channel MOS circuit contains an arithmetic logic unit, an accumulator, a 512-bit scratch-pad memory, a W register, two 8-bit bidirectional I/O ports, clock circuits to control all circuits in the F8 system, an interrupt control circuit and a power-on detect circuit. The F8 requires fewer external components than any other microprocessor available, making it truly cost effective across a broad spectrum of applications.

For further information contact Fairchild, Micro Systems Division, 1725 Technology Drive, San Jose, CA 95110; (408) 998-0123.

CIRCLE INQUIRY NO. 72

Motorola's Digital Processor Systems

Motorola manufactures three processor chip sets that satisfy the current breadth of applications in numerous market segments. Fabricated in three of the many technologies that the Semiconductor Group offers, the processor lines are: the NMOS M6800 Systems, the ECL M10800 System and the Schottky-TTL M2900 System.



The 8-bit, fixed-instruction set MC6800 Microprocessor, its compatible memory and I/O devices, and a wide variety of interface components, is being utilized for consumer, industrial and computer peripheral applications.

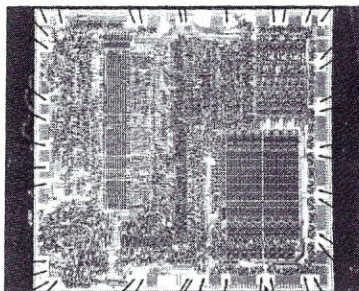
The M2900 System is the latest member of the Motorola processor line-up. This Schottky-TTL series is used for systems that require a greater throughput than can be achieved with a MOS processor. The microprogrammable 4-bit slice (MC2901), the microprogram sequencer (MC2909) plus additional Family products and compatible memories can be configured to emulate many existing machines.

For further information contact Motorola Semiconductor Corp., P.O. Box 20912, Phoenix, AZ 85036

CIRCLE INQUIRY NO. 73

Z80 Chip Offered by Mostek

The new Z80 microprocessor CPU from MOSTEK replaces the equivalent of three circuits in the 8080A up, with only a 10 percent increase in chip size. Size has been minimized through use of a sophisticated internal bus structure, totally new architecture, a high-speed, four-bit ALU, a single supply that minimizes voltage bussing, and a single-phase clock.



In addition to a 25 to 50 percent reduction in memory requirements and a 25 to 100 percent increase in throughput, the MOSTEK Z80 provides more than twice the number of instructions of the 6800 or the 8080A. The original 78 instructions and OP codes of the 8080 are part of the Z80's instruction set.

For further information contact Mostek Corporation, P.O. Box 169, 1215 West Crosby Road, Carrollton, TX 75006; (214) 242-0444, Telex 730423.

CIRCLE INQUIRY NO. 74

Texas Instruments Announces Additions to 9900 MP Family

Texas Instruments Incorporated will add a new microprocessor and four peripheral circuits to its TMS 9900 family.

The TMS 9980 is a new MOS microprocessor — a lower performance version of the powerful 16-bit TMS 9900 microprocessor. It is packaged in a 40-pin DIP, and executes the full 9900 instruction set including hardware multiply and divide.

The TMS 9901 is a programmable systems interface using NMOS technology. It can be used with 9900 or 9980 systems. The 9901 interfaces directly to the processor CRU port, and provides three functions — interrupt prioritization I/O control and interval timing.

The TMS 9902 is an NMOS asynchronous communication controller (UART) which can take advantage of the CRU I/O port of the 9900 and 9980.

The TMS 9903 is an NMOS peripheral which performs the synchronous communication control, and also interfaces to the 9900 and 9980 via the CRU I/O port, which allows it to be packaged in a 20-pin 300 mil DIP.

The TIM 9904 generates four TTL-level clock phases to drive the other support chips (9901, 9902, 9903). Samples of the TIM 9904 will be available in the third quarter.

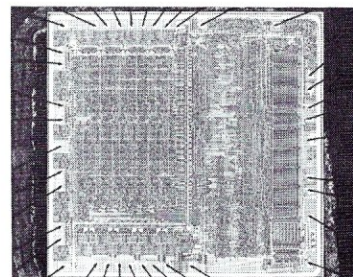
Pricing on all five new parts will be announced when samples are available.

For further information contact Texas Instruments Inc., P.O. Box 5012, MS/84, Dallas, TX 75222, Attn: "9900 Family."

CIRCLE INQUIRY NO. 75

M6800 Microcomputer Family

The Motorola M6800 family of parts has been designed to set the standard for microcomputer system architectures.



One of the initial goals was to minimize the number of required components and support packages. This was accomplished by designing the MC6800 Microprocessor with the total system problem in mind.

For further information contact Motorola Semiconductor Products, Box 20912, Phoenix, AZ 85036.

CIRCLE INQUIRY NO. 76

Faster 8080A Processors

Two high-performance 8080A microprocessors have been added to the uCOM-8 product line of NEC Microcomputers Inc. The uPD8080A-2, with a clock frequency of 2.5 MHz, is 25 percent faster, and the uPD8080A-1, with a 3.0 MHz clock frequency, is 50 percent faster than NEC's standard 8080A processor, which has a 2.0 MHz clock. NEC also offers an economical 1.25 MHz clock processor, the uPD8080A-E.

For further information contact NEC, Five Militia Dr., Lexington, MA 02173; (617) 862-6410.

CIRCLE INQUIRY NO. 77

MCS650X Microprocessor

The MCS6501-MCS6505 represent the first five members of the MCS650X microprocessor family. This family of products includes a range of software compatible microprocessors which provide a selection of addressable memory range, interrupt input options and on-chip clock oscillators and drivers. The family includes the 40 pin MCS6501 for

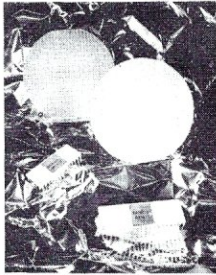
clock compatibility with the MC6800 microprocessor, the 40 pin MCS6502 with the same features as the MCS6501 but including an on-chip clock, and the 28 pin MCS6503, 5 and 5 providing in addition to the on-chip clock a set of options allowing the user to tailor his microprocessor to suit the particular need.

For further information contact MOS Technology, Inc., Valley Forge Corporate Center, 950 Rittenhouse Road, Norristown, PA 19401.

CIRCLE INQUIRY NO. 78

2901 Microprocessor

Raytheon Semiconductor has announced the availability of the 2901 Microprocessor Slice and the 2909 Microprogram Sequencer.



The 2900 series is a set of general purpose LSI components for the designer of PROM controlled and bus-oriented systems. The components are easy to use, meshing well with existing TTL components, and with conventional approaches to microprogram control. The 2901 features a straight-forward data flow, 16 general purpose registers, and 105 nanosecond cycle time.

For further information contact Raytheon, 350 Ellis St., Mountain View, CA 94040; (415) 968-9211.

CIRCLE INQUIRY NO. 79

Z-80 CPU with 4, 8 and 16-Bit Operations

The Z-80 CPU microprocessor offers many powerful features and innovations at low cost. The device, a single chip, n-channel processor, combines high speed (20% faster than an 8080A), and a repertoire of 158 instructions including those of the 8080A plus software compatibility, to attain greater system design economy and performance. Also featured are built-in refresh for dynamic memory, single 5V power supply, 17 internal registers, direct indexing, relocatable software and single phase TTL clock.

For further information contact Zilog, Inc., 170 State St., Suite 260A, Los Altos, CA 94022.

CIRCLE INQUIRY NO. 80

16-Bit Single-Chip Microprocessor

The CP1600/1600A Microprocessor Units from General Instrument Corp. are compatible members of the Series 1600 MicroProcessor Products family. Each is a complete, 16-bit, single chip, high speed MOS-LSI Microprocessor. The Series 1600 family is fabricated with General Instrument's N-Channel Ion-Implant GIANT II process, insuring high performance with proven reliability and production history. All members of the Series 1600 family, including Programmable Interface Controllers, Read Only Memories, and Random Access Read/Write Memories are fully compatible with the CP1600/1600A.

For further information contact General Instrument Corp., Microelectronics Div., 600 W. John St., Hicksville, NY 11802; (516) 733-3130.

CIRCLE INQUIRY NO. 81

Call Your IMS Dealer Today

ARIZONA: Phoenix, Arizona Micro Systems, (602) 993-4278; **Tempe**, Byte Shop #13 of Phoenix; **ARKANSAS:** Fort Smith, West Ark Computer Systems, (501) 646-3421; **CALIFORNIA, NORTHERN:** Berkeley, Byte Shop #10, (415) 845-6366; Kentucky Fried Computers, (415) 527-6760; **Campbell**, Byte Shop #3, (408) 377-4685; **Chico**, Micro-Byte, (916) 345-9396; **Citrus Heights**, Mike Anastasion, (916) 440-7216; **Daly City**, Action Audio Electronics, (415) 756-7440; **Davis**, Coyote Computers, (916) 752-2540; **Dublin**, Electric Brain Company, Inc., (415) 828-7480; **Fremont**, William Frick, (415) 792-9944; **Casual Bedding**, (415) 796-4555; **Hayward**, Computer Systems Unlimited, (415) 278-2667; **Morgan Hill**, Metatec Corporation, (408) 779-8150; **Mountain View**, Byte Shop #1, (415) 969-5464; **Rebo**, (415) 965-8581; **Oakland**, Robert H. Edmonds, (415) 834-3611; **Pass Time Enterprises**, (415) 654-5622; **Palo Alto**, Byte Shop #5, (415) 327-8080; **Microprocessor Marketing**, (415) 494-2011; **Sacramento**, Babylon Electronics, (916) 334-2161; **San Francisco**, Computer Store of San Francisco, (415) 431-0640; **San Jose**, Byte Shop, Incorporated, (408) 286-4545; **Byte Shop #7**, (408) 226-8383; **San Rafael**, Byte Shop #9, (415) 457-9311; **Santa Clara**, Byte Shop #2, (408) 249-4221; **Santa Cruz**, Byte Shop #6, (408) 425-1434; **Sunnyvale**, Edwin Hatch, (408) 245-4212; **Walnut Creek**, Byte Shop #11, (415) 933-6252; **CALIFORNIA, SOUTHERN:** Costa Mesa, Educational Properties Inst., (714) 642-9050; **Fullerton**, Bits 'n Bytes, (714) 525-9613; **Granada Hills**, Byte Shop of Tarzana, #17, (213) 678-0311; **Huntington Beach**, Byte Shop #14, (714) 549-9011; **Orange**, Computer Mart of Los Angeles, (714) 633-1222; **Pasadena**, Byte Shop #12, (213) 684-3311; **San Diego**, Computer Center, (714) 292-5302; **San Gabriel**, Sunny Sounds, (213) 287-1811; **San Luis Obispo**, Proko Electronics, (805) 544-5441; **Santa Barbara**, Channel Radio & Electronics, (805) 965-8551; **Upland**, Upland Computer Labs, (714) 981-1503; **Van Nuys**, Computer Components Inc., (213) 786-7411; **COLORADO:** Boulder, Inter-Mountain Digital, (303) 492-6061; **Denver**, Smith Systems Associates, (303) 744-6921; **CONNECTICUT:** Cheshire, JRV Corporation, (203) 771-4193; **West Haven**, Radio Communication Service, (203) 933-2432; **FLORIDA:** Jacksonville, Douglas Computer Systems, (904) 725-8158; **Miami**, Danco Electronics, (305) 235-0337; **Pinellas Park**, Elecon Corporation, (813) 541-3021; **St. Petersburg**, Offshore Marine & Electronics, (813) 345-3974; **Tampa**, Microcomputer Systems, Inc., (813) 879-4301; **GEORGIA:** Atlanta, Atlanta Computer Mart, (404) 455-0647; **HAWAII:** Cham-inade College of Honolulu, (808) 732-1471; **ILLINOIS:** Champaign, The Numbers Racket, (217) 352-5435; **Chicago**, Bronson & Bratton, Inc., (312) 735-6200; **Cicero**, Digital Research Systems; **Evanston**, Itty Bitty Machine Company, (312) 328-6800; **Lake Forest**, Curtis Enterprises, (312) 234-5328; **Hazelcrest**, Quality Security Systems, Inc., (312) 799-7900; **Oakbrook**, Creative Electronics, (312) 887-7699; **INDIANA:** Bloomington, Data Domain, (812) 334-3607; **IOWA:** Des Moines, Midwest Computer Store, (515) 243-4032; **KENTUCKY:** Lexington, Wespro, (606) 278-2578; **Louisville**, Cybertronics, Inc., (502) 499-1551; **LOUISIANA:** Baton Rouge, Executone Microcomputer, (504) 927-7660; **MASSACHUSETTS:** Boston, American Used Computer Corp., (617) 261-1100; **Waltham**, Computer Mart, Inc., (617) 899-4540; **MARYLAND:** Rockville, Computer Workshop, Inc., (301) 468-0455; **MICHIGAN:** Ann Arbor, Computart, Inc., (313) 994-4445; **Maybee**, Small Scale Systems, (313) 973-9311; **Oak Park**, Inatome & Associates, (313) 542-4862; **Troy**, General Computer Co., (313) 362-0022; **MINNESOTA:** Eagar, Byte Shop of Minnesota, #21; **St. Paul**, Microprogramming Inc., (612) 454-8857; **NEW HAMPSHIRE:** Nashua, Ronald Cordova, (603) 889-0691; **Union**, Computer Shop, (603) 473-2323;

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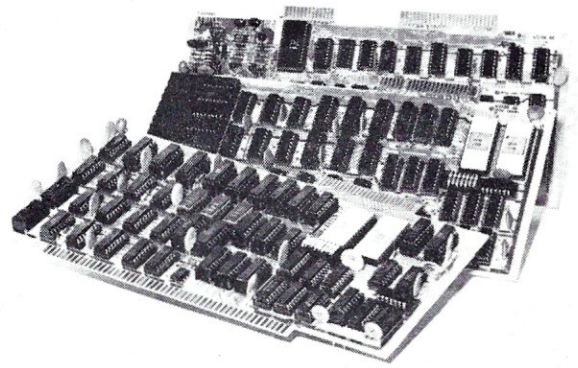
There's another side of IMSAI you should know

Sure you know our IMSAI 8080 computer. Its size, quality, performance and price set the industry standard for value. There's another, equally important side of IMSAI—our broad and ever growing I/O product line. Right now IMSAI offers an array of sensibly priced, versatile, high-quality interfaces and peripherals that live up to the IMSAI 8080 for quality, technical leadership, and value.

IMSAI VIDEO DISPLAY. We call it the most powerful, flexible video display interface available. With up to 3 boards that fit into your IMSAI you can display color characters and color graphics simultaneously. • Unlimited image control. • Large capacity display. • Eight colors; 7 half tones. • All cables included. • Full ASCII character set. • Character blink, reverse video, multiple cursor and double-width characters.

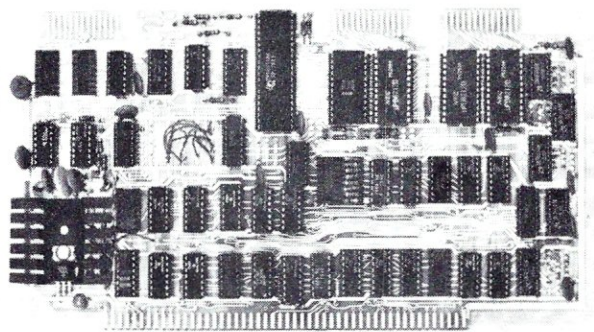
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IMSAI MULTIPLE I/O BOARD
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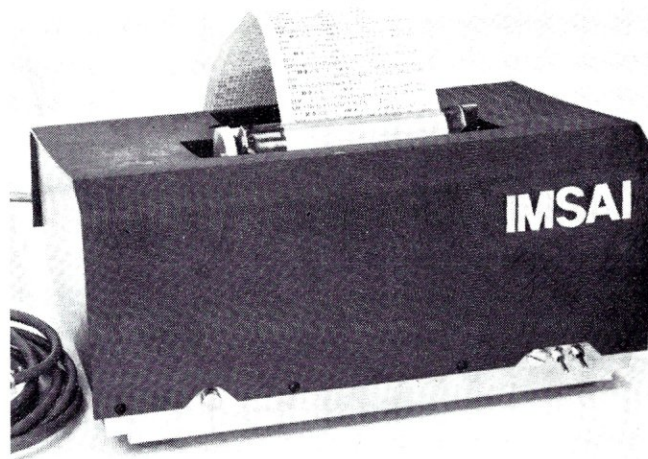


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MICROCOMPUTERS

Portable Microcomputer System Offers Built-In I/O Peripherals

The DE68 is a fully-configured, portable microcomputer structured around the widely used 6800 microprocessor and packaged in an attache-style carrying case.



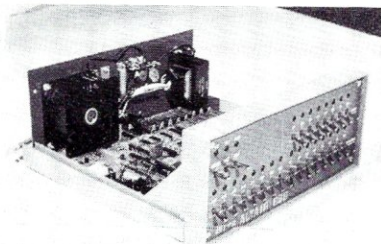
Unlike most microcomputers, which can at best offer the computer user an interface to an external CRT terminal or teletype, DE68 is a stand-alone system equipped with built-in I/O support peripherals. These "micro"-peripherals include a 96-character keyboard, a miniature cassette tape system for storage of up to 100k bytes of program or data per cassette, and a twenty-column alphanumeric display for operating system interactive communication. An optional Micro-Printer is also available to provide the system with built-in hardcopy output capability.

For further information contact Digital Electronics Corporation, 415 Peterson Street, Oakland, CA 94601; (415) 532-2920.

CIRCLE INQUIRY NO. 82

Altair 680B

The Altair 680b microcomputer is an excellent compromise between computer power and low cost structure, without sacrificing design reliability. The system is based on the 6800 microprocessing unit, which adapts nicely to a minimum design configuration. The Altair 680b measures 11-1/16" wide x 11-1/16" deep x 4-11/16" high. The basic system is available in two configurations—a turnkey model and a full front panel model—depending upon the intended application.



The main PC Board fits along the bottom of the Altair case and plugs directly into the front panel board. It contains the new 6800 microprocessor, 1,024 bytes of additional PROM or ROM, and a single Interface port with a Motorola ACIA serial interface adapter which can be configured either RS-232 or TTY. A five level Baudot interface option is also available.

The 680b is supported by its own 16k memory board, a Universal I/O board and Altair 680 BASIC software.

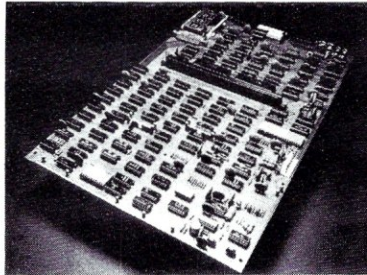
For further information contact MITS, 2450 Alamo SE, Albuquerque, NM 87106; (505) 243-7821.

CIRCLE INQUIRY NO. 83

Sol PC for Computer Intelligent Terminal Use

A highly sophisticated all on one board PC kit for use as either a computer or intelligent terminal has been announced by Processor Technology, Emeryville, California manufacturer of small computer kits and associated modules.

Known as the Sol Terminal Computer, the new unit with all memory and interface electronics including video display, keyboard interface, audio cassette interface, all necessary software plus the ability to accept the Processor Technology line of memory and interface modules sells for \$475 in kit form.



The Sol can be used as a microcomputer, low cost CRT terminal, and editing terminal. Built around the 8080 microprocessor, the Sol terminal consists of a PC assembly with the microprocessor, 512 eight-bit bytes of PROM on a plug-in personality module, 2048 eight-bit words of RAM, a 1024 character video display generator, keyboard interface, serial and parallel interfaces for connection to external devices and an edge connector for memory expansion. Optional extras include a power supply, video monitor, ASCII keyboard and case. Other options are a floppy disk system, high speed papertape reader, PROM programmer and color graphics interface.

Because the Sol uses the 8080, memory can be expanded to 65k bytes. The Sol is completely compatible with Imsai, Altair and other S-100 bus computers.

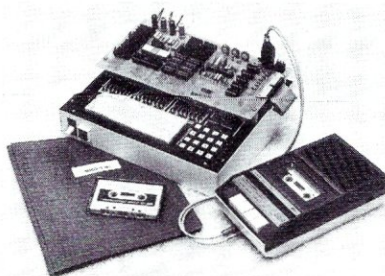
For further information contact Processor Technology, 6200 Hollis Street, Emeryville, CA 94608; (415) 652-8080.

CIRCLE INQUIRY NO. 84

Low-Cost Microcomputer System Makes Learning Microprocessors Easy

A new educational microcomputer system, based on the 8-bit 8080A microprocessor, designed for classroom instruction or home study for people with no previous experience in computer programming and only a fundamental knowledge of electronics.

The Mini-Micro Computer (MMD-1) from E&L Instruments, Derby, Conn., includes all the hardware, firmware and easy-to-understand instructions necessary for learning basic microcomputer programming and interfacing. The course organization emphasizes the role of the microprocessor in machine and process control applications.



A completely assembled and tested MMD-1 ready for use sells for \$540 each. In kit form with all parts ready for assembly, the price (including all instructional materials) is \$380.

For further information contact E & L Instruments Incorporated, 61 First Street, Derby, CT 06418; (203) 735-8774 Telex 963536.

CIRCLE INQUIRY NO. 85

Complete Microprocessing System For Under \$250

The Gemini system is adaptable to almost any microprocessing need. It's a single-board computer, complete unto itself. It fits standard-size 4 1/2" wide card racks. It uses a single, industry standard 22-pin double-sided edge connector which means this system will also fit right into any standard 22-pin backplane.

As a parallel processor, the Gemini-68 contains fully buffered and tristatable address and data buses.

Although the 6800 MPU can be edited to permit direct memory access, the Gemini-68 also has on-board provisions for "cycle-stealing" DMA, an important technique for critical applications where speed is a necessity.

The Gemini-68 processor/memory system components (processor board, 8K RAM board and 8K EPROM board) may be purchased separately. In quantities of 1-10, the processor and 8K RAM boards are \$245 each. These boards are shipped fully stuffed, burned in and tested. The 8K EPROM boards are stuffed with all components except the EPROMs, however EPROM sockets are provided. The 8K EPROM board (\$125) is also burned in for 24 hours and fully tested. Contact us regarding larger quantities. Allow approximately 4 weeks for delivery.

For further information contact M & R Enterprises, P.O. Box 61011, Sunnyvale, CA 94088.

CIRCLE INQUIRY NO. 86

Quay 80AI Microcomputer

The Quay 80AI is designed around the Zilog Z-80 microprocessor and runs at 2.5 MHz.



The board provides the hobbyist and experimenter with a complete microcomputer, requiring only a power supply and terminal device, or the 100 pin edge connector may be plugged into an Altair® or IMSAI® bus in place of the 8080 based CPU board.

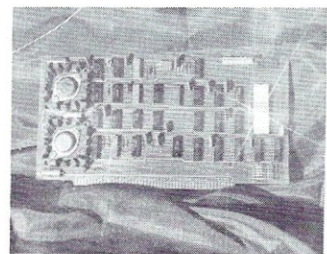
The Quay 80AI is priced at \$450.00 in kit form, and \$600.00 fully assembled. Delivery is stock to 30 days. Quay Corporation offers an Educational and Dealer purchasing plan.

For further information contact Quay Corporation, P.O. Box 386, Freehold, NJ 07728; (201) 681-8700.

CIRCLE INQUIRY NO. 87

Affordable Z-80 CPU

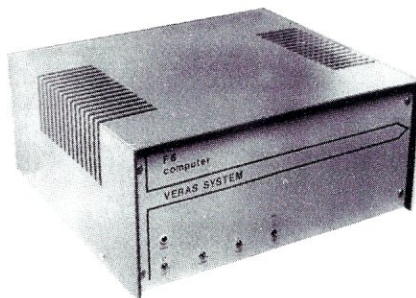
Affordable Computer Products is producing a new MITS/IMS fully compatible Zilog 80 based CPU called AZPU. The unit preserves the use of all standard 8080 instructions and additional Z80 instructions.



Most notable of those added are indexed, relative, and bit addressing operations and the block transfer and search instructions. The unit comes with a 2MHz crystal controlled clock but can

WHO DARED TO CHALLENGE THE 8080 & 6800 SYSTEMS?

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7" x 16" x 14-3/4"

VERAS SYSTEMS "F-8"

A COMPLETE SYSTEM
FOR ONLY **\$459.00** KIT FORM
\$709.00 ASSEMBLED and TESTED

COMPARE STANDARD FEATURES ON BASIC SYSTEMS

YOU'LL SEE WHY THE VERAS F-8 SYSTEM WINS HANDS DOWN! *Registered Trademarks of Fairchild and Motorola

STANDARD FEATURES	VERAS F8	8080 & 8080A SYSTEMS	6800 SYSTEM
Parallel I/O Ports	(3) 8 Bit Bidirectional Brought Out To Rear Panel Conn's.	None	None
Serial I/O Port	RS-232 or TTY Brought Out To Rear Panel Term. Strip.	None	RS-232 or TTY
Interval Timers	(2) Programmable Interval Timers	None	None
Interrupts	a) Vectored Interrupt To Location 0090 Hex. b) Vectored Interrupt Programmable Location c) Two Vectored Interrupts Associated With Interval Timers d) Total of (4) Interrupts In A User Defined Priority Interrupt Structure	None	a) 2 Non Vectored Interrupts on P I A b) 2 Vectored S W I & N M I c) Total of 4 Non Prioritized Interrupts
Built In Mini Operating System in ROM For Terminal And Memory Debug	FAIRBUG*	None	MIKBUG*
Loader Program	Automatic Internal ROM	Manual Console Switches	Automatic Internal ROM
Static RAM Memory	1024 BYTES	None	2048 BYTES
Card Rack	Rugged Alum. Self Contained Card Rack/Plastic Self Aligning Card Guides	Card Supports	None
Auxiliary DC Power To Power Peripherals	+5V, -5V, +12V, -12V @ 1 Amp. Ea. Regulated At Rear Panel Terminal Strip	None	None
Basic Kit Price	\$459.00	\$539.00, \$599.00 or \$840.00 Depending On System	\$395.00

OUR 4K STATIC RAM BOARD FEATURES: (OPTIONAL)

- On board decoding for any four of 64 pages.
- Address and data lines are fully buffered.
- No onboard regulators to cause heat problems. (Chassis mounted)
- 4K memory boards with connector, buffers, static RAM's & sockets are available in kit form

\$149.00

The VERAS System can be made into a 17K processor by merely adding four of our optional memory boards. The kit includes everything you need to build the VERAS F-8 Computer as described. All boards, connectors, switches, discrete components, power supply and cabinet are supplied. Programming manual, data book and simplified support documentation supplied, 8K Assembler and Editor (paper tape or K.C. std. cassette) available on request with minimum order of 8K RAM.

THE VERAS SYSTEM

THE CPU BOARD FEATURES:

- Two I/O ports each on the CPU and ROM chip make 32 bidirectional TTI lines.
- The Fairbug* programmed storage unit provides the programmer with all I/O subroutines, allows the programmer to alter or display memory, and register its contents via teletype.
- Programmable internal timer is built into the ROM chip.
- Built in clock generator and power on reset are built into the CPU chip.
- There is a local interrupt with automatic address vector.
- It is expandable to 65K bytes of memory.
- 20 mil loop and/or RS232 interface included.
- 1K of on board 2102 RAM.
- Serial interface built into PSU chip.

*Fairbug is a registered trademark of Fairchild Corp.

TINY 2 K BASIC (AVAILABLE) OCT. 15, 1976 \$25.00
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Computer dealers and hobbyist club inquiries are invited.

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VERAS SYSTEMS

A Div. of Solid State Sales, Inc.
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(617) 547-1461

☐ Enclosed is check for \$ _____
or ☐ Master Charge # _____

☐ VERAS F-8 Computer Kit ☐ Assembled
☐ 4K RAM Board Quantity _____

Name _____

Address _____

City, State _____ Zip _____

run at 4MHz with only a crystal change. The bus is fully buffered and is regulated separately from the remaining circuits regulator.

For further information contact Affordable Computer Products, 3400 El Camino Real, Santa Clara, CA 95051; (408) 249-5834.

CIRCLE INQUIRY NO. 88

F-8 Microprocessor Design

Fairchild's F8 Microprocessor Family offers the hobbyist a complete system that requires no ROM. The system consists of the 3850 Central Processing Unit, the 3853 Static Memory Interface, and any other standard memory device, i.e., PROM or RAM, supplied by the hobbyist. This system includes 16 bidirectional I/O lines, one interrupt level, programmable timer, on-chip clock and control logic, and a 64 byte RAM on the CPU. I/O lines and interrupt levels can be expanded via the 3861 Peripheral I/O.



In addition, Fairchild offers the hobbyist a fully assembled and tested Evaluation Kit. The Kit provides an assembled microcomputer utilizing the 3850 CPU, 3851A Program Storage Unit, and 3853 Static Memory Interface. It demonstrates techniques of microprocessor programming by providing 1K byte RAM program capacity and a special debug program. The Evaluation Kit also is supplied with a prewired cable terminating in an edge connector, a teletype connector, and power supply plugs.

For further information contact Fairchild Micro Systems Division, 1725 Technology Drive, San Jose, CA 95110; (415) 962-3816.

CIRCLE INQUIRY NO. 89

The Altair 8800B

The Altair 8800b is a second generation design of the most popular microcomputer in the field, the Altair 8800.



Built around the 8080A microprocessor, the Altair 8800b is an open-ended machine that is compatible with all Altair 8800 hardware and software. It features the standard 100-pin Altair bus structure with a single-piece 18-slot motherboard. Directly addresses up to 64K of memory and 256 separate input and output devices.

For further information contact MITS, 2450 Alamo SE, Albuquerque, NM 87106; (505) 243-7821.

CIRCLE INQUIRY NO. 90

Low Cost System

Intel Corporation has a number of products of interest to the hobbyist and small business computerists. Among these products are the SBC 80/10 and 80/20 Single Board Computers, the SDK 80 System Design Kit, and the Microcomputer Software (Insite™) User's Program Library.

For further information contact Intel Literature

Department, 3065 Bowers Avenue, Santa Clara, CA 95051.

CIRCLE INQUIRY NO. 91

The POLY 88 Central Processor

The POLY 88 Central Processor puts together several features on a single card. 1/2K of RAM plus sockets for up to 3K of 2708-type PROM or ROM. On-card memory is a 4K block with a user selectable starting address (0.4K, or 28K).



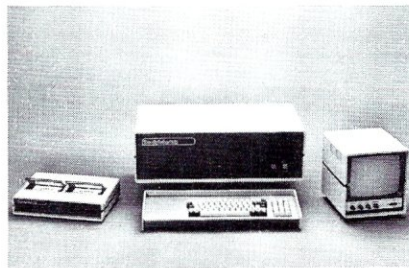
On-card memory can be "switched out" by software to read off-board memory. Eight interrupts are provided for use by I/O devices, so that processing can continue between successive inputs or outputs. Optional serial input-output port features software-controlled baud rate that lets you selectively read and write with up to two I/O devices at different baud rates. Serial option includes one or two mini-cards—part of the cable connection to the back panel—to interface with cassette or RS-232C/current loop.

For further information contact PolyMorphic Systems, 737 S. Kellogg, Goleta, CA 93017; (805) 967-2351.

CIRCLE INQUIRY NO. 92

Digital Group System

The Digital Group offers a comprehensive, easy-to-use and adaptable system for the hobbyist and businessman. The video-based system, which includes CPU, cassette storage system and a host of software packages is competitively priced and is designed to combat rapid obsolescence so often encountered in this fast-moving high technology field.



The Digital Group offers interchangeable CPUs from different manufacturers—8080, 6500, 6800 and Z-80 by Zilog—which are interchangeable at the CPU card level to protect the major investment in memory and I/O.

Prices for standard systems including cabinet, power supply, and all standard features start at \$645 for Z-80, \$595 for 8080 and 6800, and \$545 for 6500.

For further information contact The Digital Group, P.O. Box 6528, Denver, CO 80206; (303) 861-1686.

CIRCLE INQUIRY NO. 93

6800 CPU Board

Finally, a quality 6800 board for prototype or the heart of your system. Large ground plane and voltage plane, not little power traces. A 4/16 address decoder, not a host of little gates which may require trace cutting and jumpering to do the job we did right the first time. Two easy to use fast parallel interface units for I/O not a serial interface requiring an expensive teletype. Two 6810 rams for full implementation of direct addressing mode. Four

spare 24 pin sockets and six spare 16 pin sockets to do your own thing: serial I/O, display decoders, TV interface or whatever. Memory is fully expandable, and, of course, plated thru holes with large pads, quality sockets and bypass capacitors.

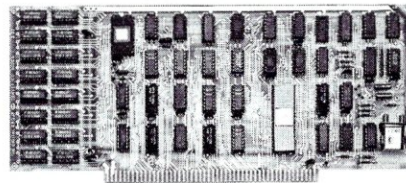
Board with sockets, \$42.50.

For further information contact Kathryn Atwood Enterprises, P.O. Box 5203, Orange, CA 92667.

CIRCLE INQUIRY NO. 94

Digital Group Z-80 System

A new generation CPU has been integrated into the Digital Group microcomputer system for the ultimate in performance. The Z-80 combines all the advantages of the 6800, 6500, and 8080 into one chip that maintains complete compatibility with 8080 software.



Features of the Digital Group Z-80 System also include 80 new instructions, 696 operation codes, extensive 16-bit arithmetic, three interrupt modes, built-in automatic dynamic memory refresh and eleven addressing modes.

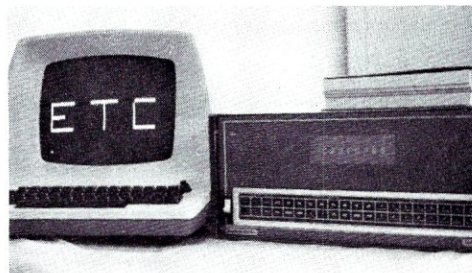
The Z-80 CPU is completely interchangeable with Digital Group 8080A, 6800, and 6500 CPU's, and a complete system is priced as low as \$475.

For further information contact The Digital Group, P.O. Box 6528, Denver, CO 80206; (303) 861-1686.

CIRCLE INQUIRY NO. 95

Multi-Micro

The ETCETERA System from Electronic Tool Company offers a compatible range of computing power from an economical Basic System to a high-performance multiple-processor computer with parallel processing, fail-safe reliability, and mixed CPU capability.



Fully assembled, tested, with power supply and enclosure, the \$725 ETC-1000 Basic System uses the MOS 6502 processor. Additional processors on plug-in modules permit addition of Z-80, 8080, F8, and 6800 CPU's. Up to eight different processors may operate within a common system, sharing software, I/O, and other resources.

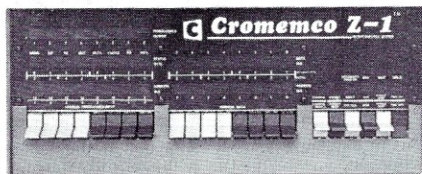
For further information contact Electronic Tool Company, P.O. Box 1315, Hawthorne, CA 90250; (213) 644-0113.

CIRCLE INQUIRY NO. 96

New Microprocessor Development System Based On The New Z-80 CPU

Cromemco is introducing a major new development tool for a major new CPU chip, the Zilog Z-80. (The Z-80 is widely regarded as the most powerful microprocessor chip available and capable of generating a new level of 'smart' devices of all types. Cromemco is, in fact, basing its new

system on the Z-80/4, an advanced version of this new CPU.)



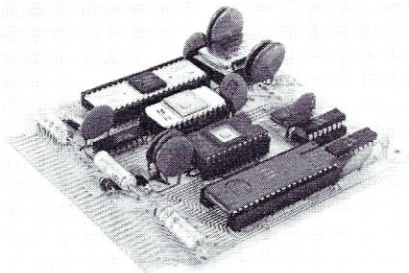
The Cromemco Z-1 is priced at \$2495 and is ready to use at that figure. A terminal can be directly plugged into its RS232 connector.

For further information contact Mr. Joe McCrate, Cromemco 2432 Charleston Road, Mountain View, CA 94040; (415) 964-7400.

CIRCLE INQUIRY NO. 97

TPU

The Sphere TPU/1 micro computer on a card designed for use in control environments; whether it be personal, Business, Industrial, or Engineering. TPU is an expandable CPU on a 4.4x4.9 inch edge connector board. With the Motorola 6800 microprocessor a 6820 parallel interface 256 or 512 bytes of EPROM 2048 bits of static RAM, and a crystal controlled clock driver. Available on the 72 pin edge connector are all the necessary signals to interface the TPU/1 to almost any device. You can program the read only memory with special instructions to meet your needs, or buy our programmed ROM's.



Build or design your own computer configuration. The static memory is expandable to 32k and you can control teletype or other I/O devices.

For further information contact Sphere Corporation, 940 North 400 East, North Salt Lake, UT 84054; (801) 292-8466.

CIRCLE INQUIRY NO. 98

Sphere 300

The Sphere Series 300 micro computer is a 8-bit parallel microprocessor system using the Motorola 6800. Properly configured the computer is capable of performing all small business functions inventory control, accounting, security alarms, etc. Play games, do personal budgeting.

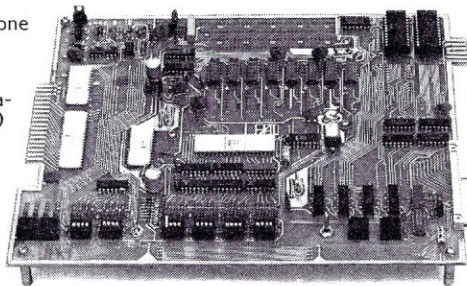


Systems are complete with CPU, CRT, Keyboard, PDS and power supply. Available options are Serial Interface with TTL, TTY, RS232, Modem, and Standard Audio Cassette. Parallel Interface offers 64 lines of digital input/output. Extra RAM memory up to 64K bytes. Peripherals include 80 character line printer, dual floppy disk memory.

For further information contact Sphere Cor-

If you want a microcomputer with all of these standard features...

- 8080 MPU (The one with growing software support)
- 1024 Byte ROM (With maximum capacity of 4K Bytes)
- 1024 Byte RAM (With maximum capacity of 2K Bytes)
- TTY Serial I/O
- EIA Serial I/O
- 3 parallel I/O's
- ASCII/Baudot terminal compatibility with TTY machines or video units
- Monitor having load, dump, display, insert and go functions



- Complete with card connectors
- Comprehensive User's Manual, plus Intel 8080 User's Manual
- Completely factory assembled and tested — not a kit
- Optional accessories: Keyboard/video display, audio cassette modem

interface, power supply, ROM programmer and attractive cabinetry... plus more options to follow. **The HAL MCEM-8080. \$375**

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Telephone (217) 367-7373

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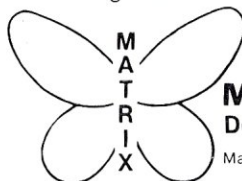
Price: \$8.95

1024 QUESTIONS AND ANSWERS ABOUT HOME COMPUTERS

Richard L. Didday

A book for the person interested in microcomputers who wants to get an idea of what it can be like before buying the equipment and for the person with a microcomputer who wants ideas for things to do, help in reading the literature, help in deciding what ways to go. 144 pages.

Price: \$4.95



MATRIX PUBLISHERS, INC.

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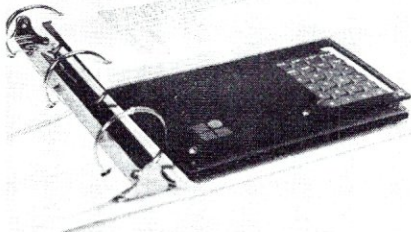
Matrix books also available in Byte Shops, computer stores, and bookstores.

poration, 940 North 400 East, North Salt Lake, UT 84054; (801) 292-8466.

CIRCLE INQUIRY NO. 99

Computer in a Book

The Iasi ia7361 Computer in a Book is an 8080 based system on a single PC board. It contains a crystal clock, an 8080A CPU, 1024 bytes of bipolar PROM containing the system monitor program, three additional sockets for up to 1024 bytes of PROM, eight 2102 RAMs with capacity of 1024 bytes of program and data storage, a 24 key keyboard and eight 7-segment displays. I/O consists of two TTL compatible I/O ports and a set of jacks that can be connected to a consumer cassette tape recorder. This allows the user to store and retrieve programs on inexpensive cassette tapes.



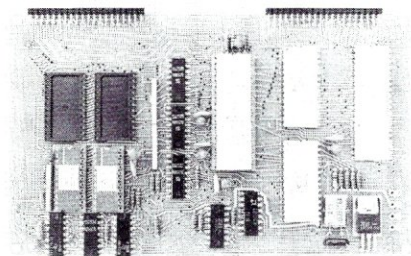
The price of the ia7301 Computer In A Book will be \$420.00 in quantities of one. The introduction date is estimated as October 19th.

For further information contact IASIS Inc., 815 W. Maude Ave., Sunnyvale, CA 94086.

CIRCLE INQUIRY NO. 100

8080 OEM Microcomputer System Card and Support Software

Microcomputer Associates Inc. (MAI), manufacturers of microcomputer-based kits, boards, and systems, has begun shipment of 8080A/9080A OEM cards, the smallest, most powerful microcomputer-based system card available on today's OEM market.



A full set of additional support boards including RAM cards, PROM cards, I/O cards and Power Supply cards, allow the user to easily tailor a system to his specific needs. The 8080A/9080A card is fully assembled and tested.

For further information contact Ray Holt or Manny Lemas, Microcomputer Associates Inc., 2589 Scott Boulevard, Santa Clara, CA 95050; (408) 247-8940.

CIRCLE INQUIRY NO. 101

6800 μ P System Analyzer/Controller

A O Systems has introduced an inexpensive yet complete 6800 μ P development and debugging tool. Standard functions include: setting and examining registers, Examining & Depositing in Memory (65K), Hardware Breakpoint & Monitor, Run/Halt, and Single Step.

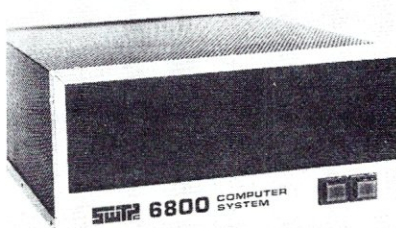
Model MPA AO 6800 can be connected to any 6800 μ P system without placing constraints on the system hardware or software design. The price for Model MPA AO 6800 is \$695.

For further information contact A O Systems, Inc., 1736 Front Street, Yorktown Heights, NY 10598; (914) 962-4264.

CIRCLE INQUIRY NO. 102

M6800 Based Low Cost Microcomputer System Kit

Southwest Technical's SWTPC 6800 Computer System kit is based on the Motorola M6800 family of parts.



The low \$395.00 price includes all components, boards, hardware and documentation necessary to build a computer system which includes a ROM stored mini-operating system, 2048 words of RAM memory, RS-232/TTY serial interface, power supply, chassis and cover. The system is expandable to 16,384 words of RAM memory with up to eight serial or parallel interfaces making it ideal for both stand alone and prototyping applications.

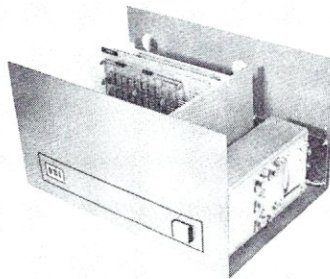
For further information contact Southwest Technical Products Corporation, 219 W. Rhapsody, San Antonio, TX 78216; (512) 344-0241.

CIRCLE INQUIRY NO. 103

OSI Challenger

The OSI Challenger is the computer for both the beginner and the experienced computer enthusiast. The Challenger is by far the easiest and most economical way for the beginner to get on line.

For example, if you purchase a 4K Challenger 68, you get BASIC free on paper tape with the computer. To bring BASIC on line, you simply remove the computer from its shipping carton, connect it to an ASR33 teletype with four wires (included), plug the machine in, turn it on, place BASIC in the reader, and type an "L". The computer will automatically load and execute the program. That's all there is to it! You can be up and running in BASIC 30 minutes after you receive your Challenger!



All Challenger memories operate at full processor speed, making the Challenger much faster than any hobby computer.

For further information contact Ohio Scientific Instruments, 11679 Hayden Street, Hiram, OH 44234.

CIRCLE INQUIRY NO. 104

Wyle Central Processor Unit

The Wyle μ P-CPU-1 is an 8-bit microcomputer central processor unit (CPU) using the Intel 8080A. The input/output bus, address bus, and control signals are all implemented on the CPU printed circuit board to produce a simple to use hardware module. The CPU board interfaces directly with Wyle μ P memory and input/output modules with no buffering required. The 3.25" x 4.5" card size is directly compatible with the Wyle logic card line making it possible to implement user designed hardware in the same card file with the microcomputer system.

For further information contact Wyle Computer

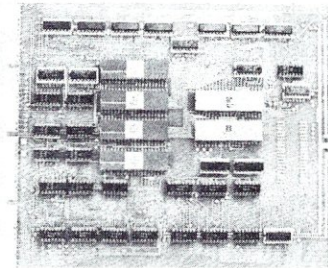
Products, A Division of Wyle Laboratories, 3200 Magruder Blvd., Hampton, VI 23666; (804) 838-0122.

CIRCLE INQUIRY NO. 105

OSI 460Z CPU Expander

The OSI 460Z CPU Expander is a totally new computer building block with phenomenal performance and flexibility. The 460Z's main purpose is to allow a user to run 8080, Z-80, and 6100 (PDP-8) software on his 400 system without modifying the software.

The 460Z contains a Z-80 and Intersil 6100 microprocessor, four PIAs for control and several multiplexers and demultiplexers.



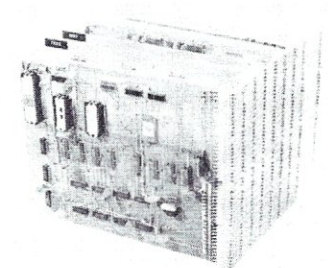
The OSI 460Z, like most other 400 series boards, is only \$29.00 bare with manual, and, as an introductory special, we are offering this unbelievable package: OSI 460Z Board Bare with Manual and an Intersil IM61001 and a Zilog Z-80 ALL for \$99.00—offer limited.

For further information contact Ohio Scientific Instruments, 11679 Hayden Street, Hiram, OH 44234.

CIRCLE INQUIRY NO. 106

The OSI 400 System Is Now 10 Boards

The OSI 400 System can be configured from a single board computer to a large multiprocessor network.



Processors handled by the OSI system include: 6800, 6502, Z-80, 6100 (PDP-8 Equivalent). System boards include: 4K RAM memory board, 8K PROM memory board with onboard PROM programmer, I/O board with A/D and D/A conversion, wireless backplane board, card extender board to aid in board servicing, prototyping board for custom designing, video graphics board, CPU board, and CPU expander board for multiprocessing — not to mention our audio cassette interface or our fabulous floppy! Yes, all 400 boards are fully compatible with the new OSI Challenger! 500NS. Cycle time and multiprocessor configuration with distributed memory and I/O are available; unprecedented performance at unbelievably low cost; fully buffered design with each board capable of driving 250 system boards; simple to understand and remarkably flexible 48 line bus structure; most system boards are \$29.00 each including manual.

Yes, all 400 boards are fully compatible with the new OSI Challenger!

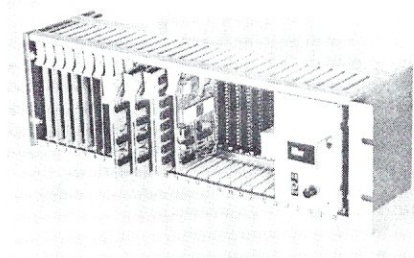
For further information contact Ohio Scientific Instruments, 11679 Hayden Street, Hiram, OH 44234.

CIRCLE INQUIRY NO. 107

Wyle Microcomputer System

The Wyle μ P Series microcomputer system is a complete processing system based on the Intel 8080A. Special hardware and software features of

the μ P Series greatly minimize time consuming detailed design and programming commonly associated with microprocessors.



Features of the Wyle μ P Series include:

A complete family of CPU, memory and I/O modules on individual printed circuit boards which interconnect directly, with no user-designed buffering required.

Analog and digital I/O modules and communications interfaces operable over the range of 0°C to 70°C.

User oriented front panel with switches and lighted displays for data input, monitoring and control. Available for use in a stand-alone version or with an interface to the DEC PDP-11.

Compatibility with the Wyle line of printed circuit logic cards, power supplies, card files and accessories. User designed logic can be implemented in the same card file with the microcomputer system.

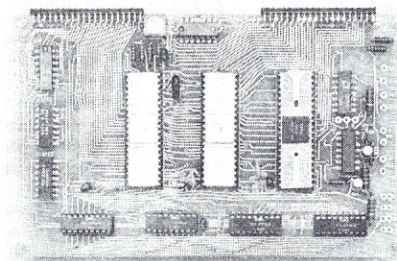
For further information contact Wyle Computer Products, A Division of Wyle Laboratories, 3200 Magruder Blvd., Hampton, VI 23666; (804) 838-0122.

CIRCLE INQUIRY NO. 108

Jolt Microcomputer

JOLT CPU Card—Includes 8-bit NMOS MOS Technology 6502 CPU, which requires no clock, can directly address 65K of memory, has two index

registers, 137 instructions with 11 "true" addressing modes, two interrupts and both single step and address halt capability.



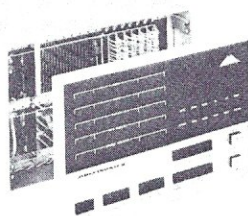
JOLT card is small - 4 1/2" x 7"—and has TTY and RS232C interface. Includes unique software 1K ROM Debugger/Monitor DEMON™, fully documented. DEMON self-adapts to any terminal speed from 10-30 CPS (110 to 300 baud).

For further information contact Microcomputer Associates Inc., 2589 Scott Boulevard, Santa Clara, CA 95050; (405) 247-8940.

CIRCLE INQUIRY NO. 109

808A Microcomputer

Multisonics Inc., of San Ramon, California announces the release of the 808A microcomputer, a new concept in computer design.



From a minimum system configuration with 1K memory to a system with up to 64K RAM, ROM or combination of both, the 808A may be tailored to enable complete processing capabilities. As well as process applications, the addition of a four drive floppy disk system, expands memory capabilities, with 1 megabyte of off-line storage. Standard Software provided (based on 16K minimum) includes an editor, relocatable linking assembler, relocatable linking loader and debug routine. Multisonics provides a standard utility package and, in addition, BASIC, EX-BASIC, FOCAL, FORTRAN and an assortment of library programs are also available.

For further information contact Multisonics, 3300 Crow Canyon Road, P.O. Box 350 San Ramon, CA 94583; (415) 837-8111.

CIRCLE INQUIRY NO. 110

Universal Microprocessor Development System for 8080, 2650 and 6800

A major new microprocessor development system is now available from Millennium that interfaces directly to the 8080 and 2650 Microprocessors. The System, Universal One, will interface to the 6800 by the end of 1976 and other microprocessors in the near future.



ACT-1 The Affordable CRT Terminal

\$525 complete with high resolution 9" monitor · \$400 without · Horizontal cursor control and bell · \$50 ■ INCLUDED FEATURES:



- 64 characters by 16 lines
- Auto Scrolling
- Underline Cursor
- RS232C or Current Loop
- Data Rates of 110, 300, 600, 1200, 2400, 4800, and 9600 baud are jumper selectable
- All oscillators (horiz., vert., baud rate, and dot size are crystal controlled)

The ACT-1 is a complete teletype replacement compatible with any processor which supports a serial I/O port. Completely assembled and dynamically tested.

Prices
FOB
St. Louis
BankAmericard
&
Mastercharge

• **VIDEO TERMINAL BOARD** · \$250 · The same circuitry as used in the ACT-1 on a single 8 1/2" x 11" board. The VTB is assembled, tested and comes complete with power supply. Add your own parallel data keyboard and monitor to produce a complete serial I/O video terminal. Available - Dec. 1 ■

MICRO-TERM INC. P.O. BOX 9387 ST. LOUIS, MO. 63117

(314) 645-3656

Universal One significantly reduces the time required to get a prototype system from design into production. It reduces expenses by speeding hardware and software development and its Universal architecture offers the greatest return on investment of any development system available today.

A basic Universal One System is available for immediate delivery for \$8,900. Millennium provides complete documentation and service.

For further information contact Robert D. Catterton, Millennium Information Systems, Inc. 420 Mathew Street, Santa Clara, CA 95050; (408) 243-6652.

CIRCLE INQUIRY NO. 111

Wave Mate's Jupiter IIC

Wave Mate's Jupiter IIC is a 6800-based microcomputer using a monitor-quality TV interface, keyboard and cassettes for a complete system. It includes 10K RAM, 3K EPROM, 8 interrupt levels, and DMA capabilities.



The video interface has a dual port memory for display refresh without using CPU cycles. The character set has upper/lower case ASCII, with 32 lines of 64 characters. Graphics mode provides 128 horizontal dots by 96 vertical.

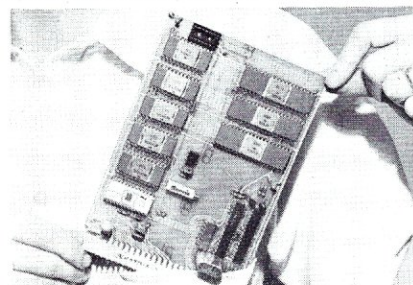
The dual audio cassette interface provides 300, 600, and 1200 baud. Price \$2,850 kit and \$3,800 assembled, tested and two cassette players.

For further information contact Wave Mate, 1015 W. 190th Street Gardena, CA 90248; (213) 329-8941.

CIRCLE INQUIRY NO. 112

Wince Micro Modules

The WINCE Control Module is a microcomputer with a 6800 MPU, clock, 1K bytes EROM or 2K bytes ROM, 512 bytes RAM, ACIA, (UART) serial i/o, 2 PIA's (32 TTL lines parallel I/O) and is fully expandable to 65K bytes RAM, ROM, I/O.



Other WINCE modules include a RAM module loaded with 4, 8, 12, or 16 K bytes RAM, a ROM module with sockets for up to 16 1K EROMS or ROMS, an EROM Programmer, and an 8 channel 8 or 10 bit A/D and D/A module. The student configuration of the WINCE Control Module shown in the picture will be given "FREE" to each attendee of Wintek's 3-day Hands-On μ P Short Course With Take Home Microcomputer to be offered in many locations in January, February, 1977. Tuition is \$495.

For further information contact Wintek Corporation, 902 N. 9th Street, Lafayette, IN 47905; (317) 742-6802.

CIRCLE INQUIRY NO. 113

The Data Handler

The Data Handler is a complete microcomputer system on a single printed circuit board designed

around the Mos Technology 6502 microprocessor.

This complete microcomputer system contains 1K bytes of random access memory, one eight bit parallel input port with data latch and interrupt strobe, and one eight bit parallel output port with clearable data flag.



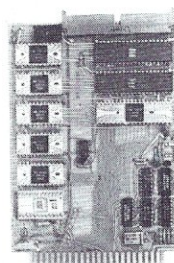
The Data Handler contains a 26 keyboard switch hardware controlled front panel which will load data, examine data, perform single cycle and single instruction, initialize the system, run and halt the system all in hexadecimal format.

For further information contact Western Data Systems, 3650 Charles Street, Suite G, Santa Clara, CA 95050; (408) 984-7804.

CIRCLE INQUIRY NO. 114

Take Home A Micro

Wintek Corporation has scheduled its popular 3-day "HANDS-ON MICROPROCESSOR SHORT COURSE WITH TAKE HOME MICROCOMPUTER" at nine locations next February and March. Each attendee receives a microcomputer to use at the course and then take home — a WINCE MICRO module including a 6800 MPU, clock, ROM, RAM, serial and parallel I/O.



It is fully expandable using WINCE RAM and ROM modules. The ROM contains FANTOM II, a monitor/debug program that allows single step execution of user programs, insertion and deletion of break points, and set up of interrupt vectors as well as allowing user to load and dump programs, examine and change memory and registers, and reset. The course covers microprocessor hardware, software, firmware, and economics. Tuition is \$495. Course locations include Boston, Chicago, Dayton, Huntsville, Los Angeles, St. Petersburg Beach, Palo Alto, Philadelphia, and Washington, D.C.

For further information contact Wintek Corporation, 902 N. 9th Street, Lafayette, IN 47904; (317) 742-6802.

CIRCLE INQUIRY NO. 115

WYLE Microcomputer On-Line Development System

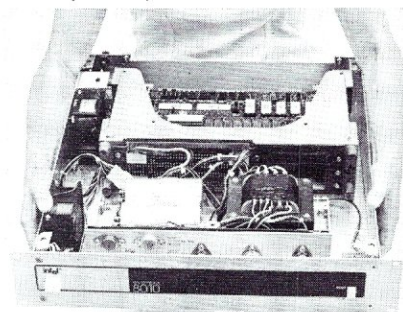
MODS (Microcomputer On-Line Development System) is a powerful, user oriented microcomputer hardware and software development tool for use in the design of microcomputer systems based on the Wyle μ P series. The μ P series is a complete system of modules that, together with the existing line of Wyle logic card modules, presents a complete spectrum of microcomputer system development capabilities. The Wyle μ P-CPU-1 central processor unit is designed around the Intel 8080A.

For further information contact Wyle Computer Products, A Division of Wyle Laboratories, 3200 Magruder Blvd., Hampton, VI 23666; (804) 838-0122.

CIRCLE INQUIRY NO. 116

Intel Announces New Low Cost Packaged OEM Microcomputer System

Based on the Intel SBC 80/10 Single Board Computer, the System 80/10 contains all the memory and I/O hardware required for a wide range of OEM applications. The System 80/10 can be enhanced with the addition of up to three optional memory and/or I/O expansion boards. Software can be developed for specific OEM applications and may reside in either non-volatile read-only-memory or random access memory.



The System 80/10 is available from stock at a single-unit price of \$1,495. Price is less than \$1,000 in OEM production quantities.

For further information contact Intel Corporation, 3065 Bowers Avenue, Santa Clara, CA 95051.

CIRCLE INQUIRY NO. 117

The Micro Designer

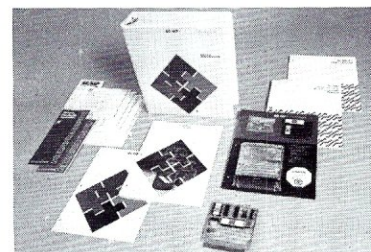
The Micro Designer is a unique developmental microcomputer system that can be used equally well in Education, Industry and Research and Development. The open configuration allows direct, solderless access to all buss lines, control signals and power on the new interface socket. It is fully supported by the Bugbook III written by Larsen, Rony and Titus that approaches teaching microcomputers in an unusually straight forward manner. It teaches the user in a programmed manner about every phase of hardware and software needed to become competent in the implementation of microcomputers to real world situations.

For further information contact E & L Instruments Incorporated, 61 First Street, Derby, CT 06418; (203) 735-8774.

CIRCLE INQUIRY NO. 118

Complete "SC/MP" 8-Bit Microcomputer Kit

A completely functional 8-bit microcomputer system, based on the "SC/MP" microprocessor, can be assembled in less than 50 minutes with National Semiconductor Corp.'s new "SC/MP Kit."



The SC/MP Kit includes all the firmware and components that a person needs to build a working system.

For further information contact "SC/MP" Marketing, Hash Patel, 2900 Semiconductor Drive, Santa Clara, CA 95051; (408) 732-5000.

CIRCLE INQUIRY NO. 119

The MD-1 Developmental Microprocessor System

A powerful device that is oriented towards hard-

ware and interfacing. The MD-0 and MD-1 systems now come with an additional 1K of R/W memory plus an extra DEC-2 for interface construction that can be used for semi-permanent circuitry.

For further information contact E and L Instruments, Inc., 61 First St., Derby, CT 06418; (203) 735-8774.

CIRCLE INQUIRY NO. 120

KIM-1 A Complete Microcomputer System for \$245

MOS Technology, Inc. has begun deliveries of the KIM-1 Microcomputer System.



The unit includes a single module, full documentation, and all monitor and operating programs stored in ROM.

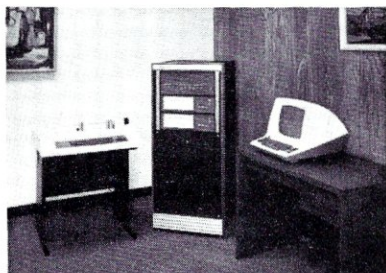
KIM-1 is NOT a kit! The system is completely assembled, fully tested, and warranted against all defects.

For further information contact MOS Technology, Valley Forge Corporate Center, 950 Rittenhouse Road, Norristown, PA 19401; (215) 666-7950.

CIRCLE INQUIRY NO. 121

Microcomputer-Based Small Business Accounting System

Administrative Systems, Inc. recently announced a breakthrough in the price/performance ratio of small business computer systems.



The Phase/One microprocessor-based system consists of a MITS 8800A computer with 16K bytes of RAM, two or more floppy disks, and ADM-3 CRT terminal, and an LA-36 printer terminal, plus individually tailored applications programs to perform accounts payable, accounts receivable, payroll, general ledger, inventory control and job-cost analysis. The basic system handles 2,000 accounts receivable, 2,000 accounts payable, 2,000 employees on payroll or 650 general ledger accounts. The total price for the hardware is \$9,980 and each software package is \$2,000.

For further information contact: Mal R. Lockwood, ASI, 222 Milwaukee, Suite 102, Denver, CO 80206. (303) 321-2473.

CIRCLE INQUIRY NO. 122

Training Film Controller

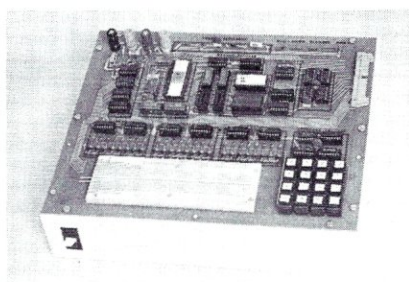
Microcomputer Associates, Inc. is currently manufacturing a 4-bit microcomputer-based interactive training-film control system. The system is delivered as a ready to use, end-user product, enclosed in a plastic case and equipped with a control keyboard and display. The entire unit is an MAI creation, encompassing specification, design, programming, prototyping and production manufacturing.

For further information contact MAI, 2589 Scott Blvd., Santa Clara, CA 95050.

CIRCLE INQUIRY NO. 123

Low-Cost Microcomputer System Makes Learning Microprocessors Easy

A new educational microcomputer system, based on the 8-bit 8080A microprocessor, designed for classroom instruction or home study for people with no previous experience in computer programming and only a fundamental knowledge of electronics.



The Mini-Micro Computer (MMD-1) from E&L Instruments, Derby, Conn., includes all the hardware, firmware and easy-to-understand instructions necessary for learning basic microcomputer programming and interfacing. The course organization emphasizes the role of the microprocessor in machine and process control applications.

A completely assembled and tested MMD-1 ready for use sells for \$500 each. In kit form with all parts ready for assembly, the price (including all instructional materials) is \$350.

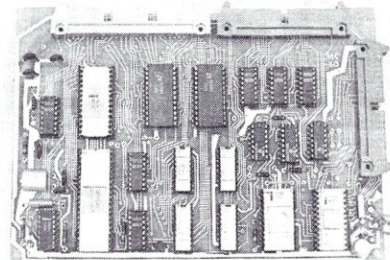
For further information contact E&L Instruments Inc., 61 1st St., Derby, CT 06418; (203) 735-8774.

CIRCLE INQUIRY NO. 124

8000 CPU Module

The GNAT CPU Module fully utilizes its NMOS, 8 bit microprocessor. The 8080 processor's 2 us cycle time, 78 instructions, unlimited subroutine nesting, vectored interrupts, and DMA capabilities

are fully developed, giving the GNAT CPU Module unmatched capacity and flexibility. This means greater ease of microcomputer-based product development and system design.



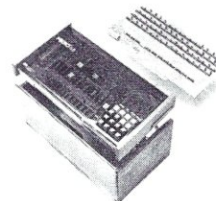
The GNAT CPU Module has been designed to operate as the central processor unit of the GNAT 8080 Micro Processor System. The module is a complete, self-contained central processor, needing only DC power to operate.

For further information contact GNAT Computers, 8869 Balboa Ave., Suite C, San Diego, CA 92123; (714) 560-0433.

CIRCLE INQUIRY NO. 125

Micro-Computer

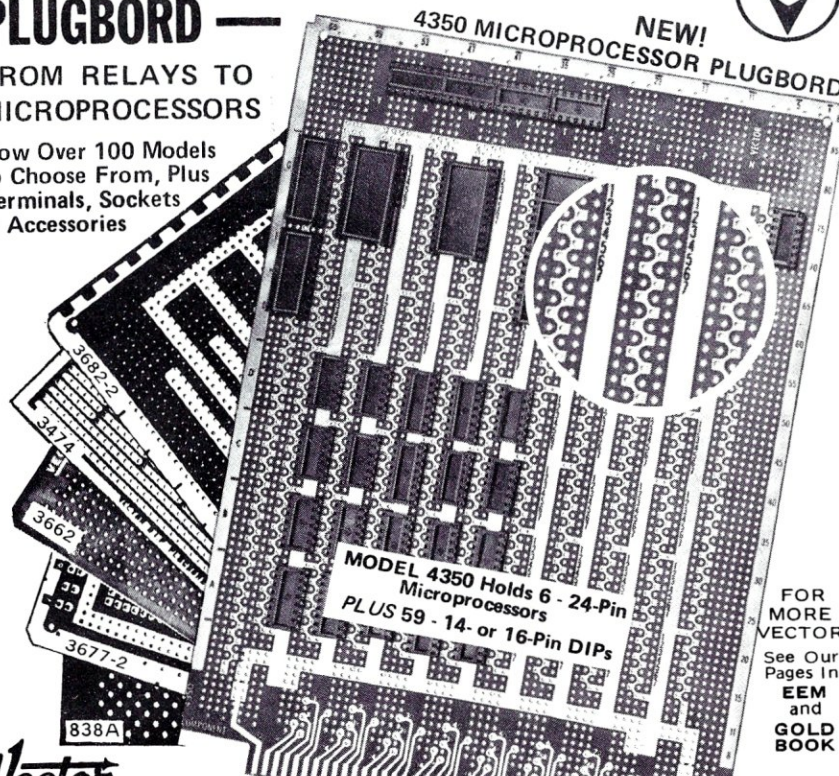
EPA has announced a complete microcomputer system, the Expanded-68, based on the Motorola/AMI/Hitachi 6800 microprocessor chip set.



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Designed for system prototype development use, the Expanded-68 comes with 8K memory, power supply, 16 digit keyboard, teletype adapter, hexadecimal LED display, expansion cabinet, application manual, and programming manual.

For further information contact Electronic Product Associates, Inc., 1157 Vega St., San Diego, CA 92110; (714) 276-8911.

CIRCLE INQUIRY NO. 126

Microprocessor Familiarizer

The 6502 Familiarizer is a microcomputer with a keyboard and display, all on a single printed circuit board, eliminating the need for a teletype or any other expensive terminal. It is designed to give the beginner "hands on" experience with a microprocessor.



The two manuals that are included can be easily understood without any prior knowledge of microprocessors. A monitor program included in PROM memory enables you to load, run, debug and modify programs easily using the on-board keyboard and hexadecimal display. Breakpoints can be entered anywhere in your program and can be used to display the internal registers or branch to a separate routine that you've loaded.

For further information contact EBKA Industries, 6920 Melrose Lane, Oklahoma City, OK 73127.

CIRCLE INQUIRY NO. 127

Module Aids Microprocessor

Texas Instruments Inc., recently announced a pre-assembled microprocessor learning module priced comparable to do-it-yourself kits, including a 160-page instruction manual.



For further information contact Texas Instruments, P.O. Box 5012, Dallas, TX 75222.

CIRCLE INQUIRY NO. 128

Apple Computer

The Apple Computer is a complete microprocessor system, consisting of a MOS Technology 6502 microprocessor and support hardware, integral video display electronics, dynamic memory and refresh hardware, and fully regulated power supplies.

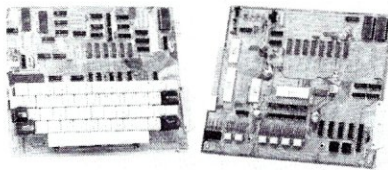
For further information contact Apple Computer Company, 770 Welch Road, Suite 154, Palo Alto, CA 94304; (415) 326-4248.

CIRCLE INQUIRY NO. 129

Single-Board Microcomputer

The HAL MCEM-8080 microcomputer is a complete operating computer on a single PC board, exclusive of power supply and teletype or CRT terminal. The 8080A CPU and its associated com-

ponents are used to insure that all of the computational power of the 8080A can be utilized.



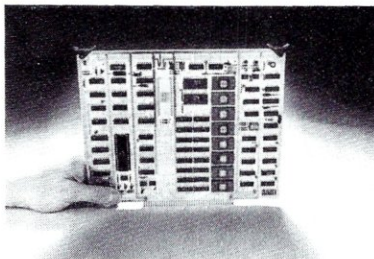
A section of the PC board is reserved for wire wrap sockets so that the MCEM-8080 can be specialized to specific applications. The MCEM-8080 is fully assembled and tested and backed by a one-year warranty.

For further information contact HAL Communications Corp., 807 E. Green St., Box 365, Urbana, IL 61801.

CIRCLE INQUIRY NO. 130

Microcomputer on Circuit Card

The Heurikon Corp. has introduced a complete microcomputer on a single printed circuit card.



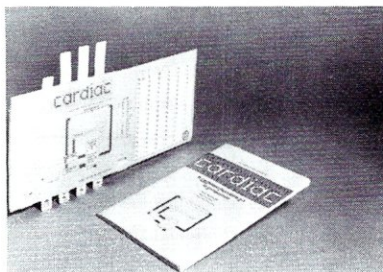
The processor, designated the MLP-8080 uses an 8080 type microprocessor chip and is designed for OEM use in control, data acquisition, and data processing systems.

For further information contact Heurikon Corp., 700 W. Badger Road, Madison, WI 53713; (608) 255-9075.

CIRCLE INQUIRY NO. 131

Computer Learning System

Cardiac is a very powerful and practical manually-oriented computer, which comes complete with a 53-page illustrative manual that explains Cardiac in terms of real computers.



The student receives his "hands-on" training by operating Cardiac through a series of ten different programs which range from the simple to the complex. Learning and comprehending this difficult subject is enjoyable, simple and rapid, and the retention factor is excellent because of the "hands-on" facet.

For further information contact Comspace Corp., 350 Great Neck Rd., Farmingdale, L.I., NY 11735; (516) 293-5525.

CIRCLE INQUIRY NO. 132

MP-12 Microcomputer

Fabri-Tek's MP12 offers designers of data acquisition systems a complete set of ready-to-go components, CPU, software, memory, I/O con-

trollers and subsystems that can handle any sensor-based application.

For further information contact Fabri-Tek Inc., 5901 South County Road 18, Minneapolis, MN 55436; (612) 935-8811.

CIRCLE INQUIRY NO. 133

Motorola EXORciser

The EXORciser is a hardware/software design, evaluation and diagnostic instrument.



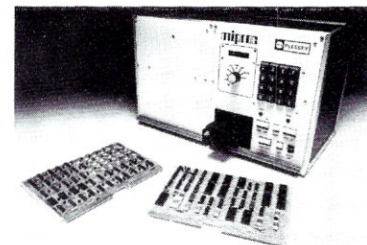
With its three basic modules, plus one or more of a series of optionally available plug-in accessory modules, it permits rapid emulation of any M6800-based microcomputer design. Built-in firmware (EXbug) allows the user to evaluate the performance of his software, the M6800 components, or the user's random logic designs.

For further information contact Motorola Semiconductor Products, Box 20912, Phoenix AZ 85036.

CIRCLE INQUIRY NO. 134

Miproc-16

The MIPROC-16 is a high speed bipolar 16-bit microprocessor on a card. It is designed for ultra high speed and high throughput applications.



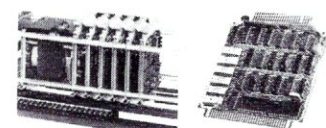
With its 350ns macroinstruction cycle time and 16-bit wide word length, the processor is capable of handling a large amount of data in a given amount of time space.

For further information contact Plessey Microsystems, 1674 McGaw Ave., Irvine, CA 92714; (714) 540-9945.

CIRCLE INQUIRY NO. 135

Comstar System 8

An 8-bit microcomputer system built around our own bipolar design. It features a micro-programmed CPU and a complete line of interface modules.



For further information contact Warner & Swasey Co., 30300 Solon Industrial Parkway, Solon, OH 44139; (216) 368-6200.

CIRCLE INQUIRY NO. 136

Now you can buy an AltairTM 8800b or an Altair 680b computer right off the shelf. Altair plug-in boards, peripherals, software and manuals are also available. Check the list below for the MITS dealer in your area.



off the shelf.

RETAIL COMPUTER STORE, INC.
Tim & Susanne Broom
410 NE 72nd St.
SEATTLE, WA 98115
(206) 524-4101

COMPUTER KITS (S. F. area)
Pete Roberts
1044 University Ave.
BERKELEY, CA 94710
(415) 845-5300

THE COMPUTER STORE
(Arrowhead Computer Co.)
Dick Heiser
820 Broadway
SANTA MONICA, CA 90401
(213) 451-0713

GATEWAY ELECTRONICS, INC.
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(303) 458-5444

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NASHVILLE, TN 37203
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(404) 231-1691

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120 Cambridge St.
BURLINGTON, MA 01803
(617) 272-8770
Jeff Feldman, Service Dept.

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Bob Arning
55 West 39th St.
NEW YORK, NEW YORK 10018
(212) 221-1404

THE COMPUTER STORE OF
Peter Blond ANN ARBOR
310 East Washington Street
ANN ARBOR, MI 48104
(313) 995-7616

THE COMPUTER STORE, INC. (Hartford area)
George & Susan Gilpatrick
63 South Main Street
WINDSOR LOCKS, CT 06096
(203) 627-0188

MICROSYSTEMS (Washington, D.C.)
Gloria & Russell Banks
6605A Backlick Rd.
SPRINGFIELD, VA 22150
(703) 569-1110

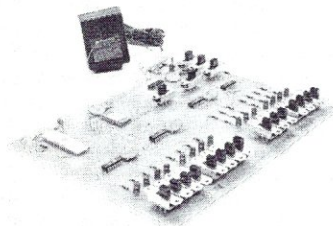
THE COMPUTER STORE
Stephen Payne
1114 Charleston National Plaza
CHARLESTON, W. VA. 25301
(304) 343-4607

MARSH DATA SYSTEMS
Don Marsh
5405 B Southern Comfort Blvd.
TAMPA, FL 33614
(813) 886-9890



Computer Trainer

The OSI Model 300 is a completely assembled and tested, ready to use, computer designed to bootstrap the student, hobbyist, and engineer into the microcomputer world.



The unit comes complete with a 20 experiment lab manual. The first experiment is simply loading and reading memory. The last experiment is interfacing the computer to a teletype. The unit has 128 words of memory (8 bits wide) and is based on the MOS Technology 6502 microprocessor which has 55 basic instructions with over 145 variations.

For further information contact Ohio Scientific Instruments, 11679 Hayden St., Hiram, OH 44234.

CIRCLE INQUIRY NO. 137

Micral Microcomputer System

These microcomputer systems are built around an 8-bit microprocessor chip.



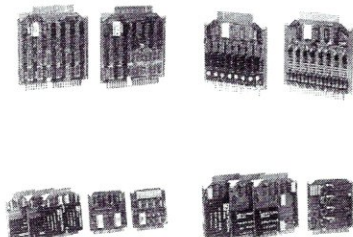
The Micral line is marketed as a series of packaged systems, including the microcomputer, interfaces, peripherals, cabinetry, power supplies, and software.

For further information contact Warner and Swasey Co., 30300 Solon Industrial Parkway, Solon, OH 44139.

CIRCLE INQUIRY NO. 138

Comstar System 4

A fourbit industrial microcomputer system built around the Intel 4040. This system includes a complete line of interface modules and peripherals.



It is intended primarily for application in the areas of Industrial Computer Control, Machine Tool Control, Material Handling and Control, Traffic Control, Remote Monitoring and Control, Batch Weighing Systems and Data Entry and Retrieval.

For further information contact Warner & Swasey Co., 30300 Solon Industrial Parkway, Solon, OH 44139; (216) 368-6200.

CIRCLE INQUIRY NO. 139

Technitrol μ Primer 4/8

The Technitrol μ Primer 4/8 is the first complete software-supported learning aid/development system for microprocessors. The standard unit initially serves as a "hands on" learning aid to familiarize the user with the processor's basic instruction set capability.

For further information contact Technitrol, Inc., 1952 E. Allegheny Ave., Philadelphia, PA 19134.

CIRCLE INQUIRY NO. 140

ACS-4040 Microcomputer

The ACS-4040 MPU PCB is a parallel 4-bit general-purpose PCB mechanized around Intel's 4040 CPU IC.

For further information contact R. A. Stevens, Automated Computer Systems, 2361 E. Foothill Blvd., Pasadena, CA 91107; (213) 449-0616.

CIRCLE INQUIRY NO. 141

Microcomputer Rentals.

Specializing in the rental of microprocessor development hardware merchandise from Pro-Log, Intel, and Motorola is stocked. This hardware includes PROM Programmers for all popular PROM's, Intel MDS and Intellec systems, Motorola EXORciser systems and supporting peripherals. Our peripherals for rent include MiniBee CRT's, CDC and iCom floppy disk drives, and paper tape readers. All equipment is available on a weekly or monthly basis at normal, not premium, short term equipment rental rates.

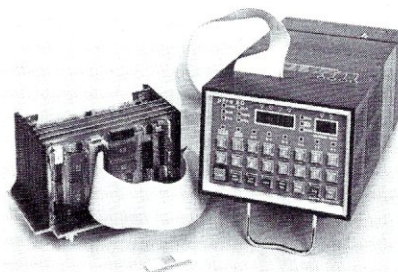
For further information contact Microcomputer Rentals, 1562 Devonshire Avenue, Westlake Village, CA 91361; (213) 991-1704.

CIRCLE INQUIRY NO. 142

PERIPHERALS

muPRO InCircuit Emulator for 8080A and 8080A-2 Microprocessors

Modular and portable (only 4.6" H. x 6.6" W. x 15.3" D.), the MuPro-80-E Emulator features a comprehensive hexadecimal control/display console, an 8080 Emulator, a heavy duty power supply, two interchangeable 40-pin leaders, interconnecting flat cable and complete user's manuals.



Shown at left of the 80-E Emulator is MuPro's Bare-Bones OEM Package representative of a typical user system under test. 8080 Microprocessor chip plugs into card in package.

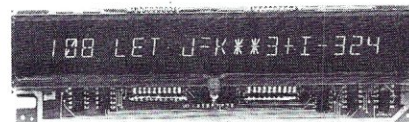
Price for single unit is \$3,250. Delivery is 30 days A.R.O.

For further information contact muPro, Inc.: Jim Moon, Director of Engineering, 10340 Bubb Rd., Cupertino, CA 95014; (408) 996-1137.

CIRCLE INQUIRY NO. 143

DE/200 Random Access Micro-Display

The DE/200 Random Access Micro-Display is an alphanumeric display peripheral designed for microcomputer system applications. The Micro-Display is provided with complete interface, drive and refresh electronics which offer universal compatibility with bus-oriented systems.



Since each of the twenty alphanumeric character positions is directly addressable, the DE/200 can be accurately described as a random access display. To display a message, a microprocessor simply writes the ASCII character codes to the appropriate display locations. Display changes are instantaneous, with no line shift effect as occurs with some types of panel displays. The added feature of period or comma insertion after each character makes the DE/200 ideal for the display of all arithmetic and linguistic expressions.

For further information contact Digital Electronics Corporation, 415 Peterson Street, Oakland, CA 94601; (415) 532-2920.

CIRCLE INQUIRY NO. 144

The Pennywhistle 103

The Pennywhistle 103 Acoustic Coupler is the first professional quality modem available in kit form. The Pennywhistle may be used either as an acoustic coupler (with the telephone handset) or it may be wired directly into the telephone. In either case, the Pennywhistle will operate in both the half-duplex (unidirectional) or the full-duplex (bidirectional) modes.



The Pennywhistle 103 is capable of recording data to and from audio tape without critical speed requirements for the recorder and it is able to communicate directly with another modem and terminal for telephone "hamming" and communications for the deaf. In addition, it is free of critical adjustments and is built with non-precision, readily available parts.

The Pennywhistle 103 modem kit is \$109.95 (plus \$2.50 for postage and handling) and is available from M&R Enterprises, P.O. Box 61011, Sunnyvale, CA 94088. California residents add 6% sales tax. Allow four weeks for delivery.

CIRCLE INQUIRY NO. 145

The EPROM Programmer 1702/1702A

The basic programmer consists of two stackable 6.5 X 9 inch cards.

The Data Entry system allows complete manual control and two hex digit display of data from either the data entry latches or from the copy socket. Data is entered from the Hex Keypad for initial programming. When the DATA IN/DATA OUT switch is in the DATA OUT position, DATA entered from the keypad is displayed as entered with DATA entering the right digit position first and moving left. In the

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Whether you have just a few boards or a full house, the **Parasitic Engineering** Power Supply Kit can deliver all the power your Altair needs. Note the performance features no simple replacement transformer can offer:

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Both kits **only \$85**

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PO BOX 6314

ALBANY CA 94706

CIRCLE NO. 32 ON INQUIRY CARD

DATA IN position, a programmed EPROM can be verified. A KEY/COPY switch allows DATA to be accessed from an existing EPROM for copying into a new EPROM. By going to KEY, individual locations can be altered as required.

Addresses are provided by two 74193 counters and displayed as two hexadecimal digits. A clear switch clears both counters to address location 00. A LOAD switch allows the contents of the DATA latches to be entered as an address.

For further information contact Associated Electronics, 17855 Sky Park Circle, Irvine, CA 92714; (714) 549-3830

CIRCLE INQUIRY NO. 146

IMSAI Introduces ASCII Keyboard

Adding to its growing list of I/O products, IMSAI of San Leandro (Calif.) announces a 53-key, ASCII Encoded Keyboard. The new keyboard is packaged in a handsome commercial grade aluminum case that is color coordinated with the IMSAI 8080 computer. It is supplied complete with connecting cable, \$199 assembled.



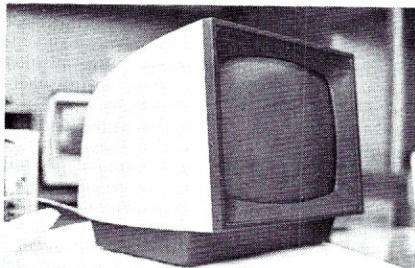
The IMSAI Keyboard offers upper case alphanumeric keys that duplicate the functions of the ASR-33. It will interface to any 8-bit parallel port and has good touch quality.

For further information contact IMS Associates, Inc., 14860 Wicks Blvd., San Leandro, CA 94577; (415) 483-2093. TWX: 910-366-7287.

CIRCLE INQUIRY NO. 147

All Purpose Video Monitor

Designed for close up digital and graphics work, this video monitor, unlike simple TV monitors, features a long-persistence green-phosphor 7 x 9 in. horizontal viewing area. The green image is amazingly steady and flicker-free.



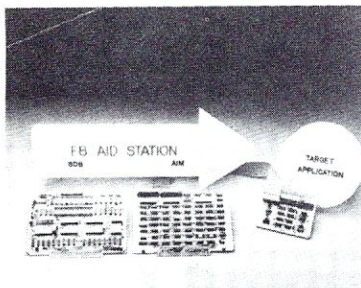
Up to 24 lines of 80 characters can be displayed on the 12" CRT. A 1/4 in. etched gradient density face plate insures viewing comfort. Spot size is .015 in. nominal. Originally components in a national intelligent terminal manufacturer's \$6,000 a terminal system, these units require only minor conversion to accept any standard 1 volt peak-to-peak video input.

For further information contact Vic Farmer, Computer Warehouse Store, P.O. Box 69, Boston, MA 02215; (617) 261-2701.

CIRCLE INQUIRY NO. 148

Mostek Introduces F8 Development Stations

Two low-cost, Aid-in-Development (AID) Stations from MOSTEK allow debugging of F8 applications in the hardware and software configuration of the final system (target). The Application Interface Module (AIM) provides for emulation of the target ROM, or PROM with RAM.



The RAM, which appears as ROM to the application, can be loaded, debugged and modified using peripherals independent of the target. The Software Development Board (SDB) allows execution and debugging of software, plus, the capability to create and edit "source" listings and assemble them into corresponding "object" code. Together, SDB/AIM provide a cost-effective approach to target application development.

For further information contact Don Ward, MOSTEK Corporation, 1215 W. Crosby Road, Carrollton, TX 75006; (214) 242-0444.

CIRCLE INQUIRY NO. 149

Key Tronic ASR 33 ASCII Keyboards

These heavy-duty keyboards feature contactless capacitance operated keyswitches.



ASCII encoding is performed by discrete logic, perfect for the creative tinkerer. These "Cadillac Keyboards" also feature a built-in repeat function. Only a single 5 volt supply is required. Key Tronic Keyboard — \$87.50 + \$5.00 shipping; Edge card connector — \$3.00.

For further information contact The Computer Corner, White Plains Mall, 200 Hamilton Ave., White Plains, NY 10601; (914) WH9-DATA.

CIRCLE INQUIRY NO. 150

TMK-132B Changes ASR-33 Teletype from 72 to 132 Print Positions

Easier, faster installation and reduced price are features of the new model B modification kit. A new print cylinder with narrow sans serif characters is supplied along with hardware to increment 132 positions on a standard TTY 8 1/2" platten.



The technique for accomplishing this has been simplified so that installation time is now just 15 minutes. The carbon ribbon supplied with the kit causes the print-out to be extremely crisp and legible. Tests have proven that the carbon ribbon lasts 50 percent longer than the standard nylon ribbon. The improved incrementing technique has proven to be extremely reliable in thousands of hours of testing. Further information may be obtained from TTS, 2928 Nebraska Ave., Santa Monica, CA 90404.

CIRCLE INQUIRY NO. 151

Info-Tech Introduces New KSR Type Terminals

Two new KSR type terminals have been developed by Info-Tech, Inc., St. Louis manufacturer of digital electronic systems for the amateur radio market and light computer use. According to the manufacturer, these new products are two of the lowest priced of their type in the electronic industry.

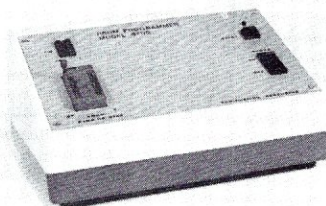


One terminal features 16 lines of 32 characters; the other 16 lines of 64 characters, both with RS 232 compatibility. They also interface with all popular microcomputer kits and any video monitor. Detailed technical information and prices on the new terminals can be obtained by writing Info-Tech, Inc., 20 Worthington Drive, St. Louis, MO 63043; (314) 576-5489.

CIRCLE INQUIRY NO. 152

2704/2708 Programmer Kit

The Model 8700 PROM programmer kit is designed to build a completely self-contained programmer for programming the 2708 and 2704 type PROM's.



The programmer is housed in an attractively styled, high impact polystyrene case and has integral power supplies. It features internal timing circuitry to handle the PROM timing requirements, allowing asynchronous operation and easy interfacing with virtually any microcomputer system, requiring only simple programs for its control. Flow charts on the data sheet describe the control programs, which must be supplied by the user.

The kit includes all the necessary hardware and design documentation to build this PROM programmer. It is easy to build. It has two circuit boards, containing all the hardware and only a few wires interconnecting the circuit boards.

The price for this kit is \$149. Delivery, stock to 4 weeks.

For further information contact Engineering Resources, 1903 Alameda Padre Serra, Santa Barbara, CA 93103; (805) 963-3801.

CIRCLE INQUIRY NO. 153

EPROM Programmer

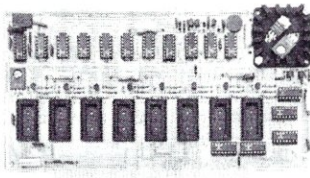
This programmer was designed for the hobbyist. All 256 locations in a 1702/1702A can be programmed in under 20 minutes. Data is entered via a hexadecimal keypad and displayed in calculator format on a large two digit LED display. The contents of an 8 bit address register are similarly displayed.

For further information contact Associated Electronics Company, 17855 Sky Park Circle, Irvine, CA 92714; (714) 549-3830.

CIRCLE INQUIRY NO. 154

New Prom Programmer

The Cromemco programmer, known as the Bytesaver is designed to program the popular 2704 and 2708 PROMs.



It is designed to be plug-compatible with the Altair 8080 or IMSAI 8800 microcomputers. The Bytesaver can give the computer up to 8K of PROM memory.

For further information contact Cromemco, One First St., Los Altos, CA 94022; (415) 941-2967.

CIRCLE INQUIRY NO. 155

PROM Programmer

Cramerkit's 2708/2704 PROM Programmer is a complete package of the components, software, and design documentation necessary to build a self-contained programmer for the popular 2708 and 2704 EPROM's. The unique design of this programmer allows the hardware to take care of all timing requirements, which allows the programmer to work asynchronously with the processor, thereby minimizing the required software. The PROM Programmer incorporates many features which make it an extremely versatile system, including a unique, all new custom prewired socket packaging board.

For further information contact Cramer Electronics, 85 Wells Ave., Newton, MA 02159.

CIRCLE INQUIRY NO. 156

Prammer

A PROM/RAM/PROM Programmer board for Altair 8800, IMSAI 8080, and compatible microcomputers. This 2K memory board contains 256 bytes of random access memory and 1792 bytes of 1702A EPROM.

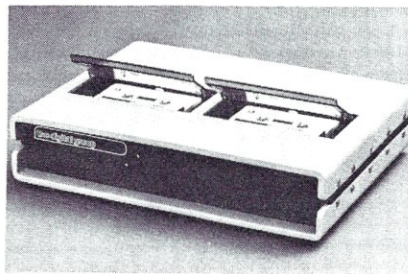
For further information contact XYBEK, 820 Sweetbay Dr., Sunnyvale, CA 94086.

CIRCLE INQUIRY NO. 157

DIGITAL RECORDERS

Cassette Storage System

The Digital Group rapid Cassette Storage System is designed to provide total magnetic tape data storage and retrieval for a microprocessor, capable of operating one to four computer-controlled Phi-Deck cassette transports.



The Cassette Storage System is ideal for such jobs as large data files, indexed computer-controlled program files, sorts, inexpensive mass storage, work files, indexed random retrieval, multi-pass compilers and system residence. In addition,

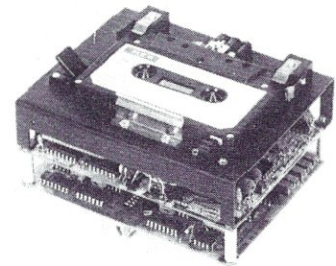
with a Digital Group system and a Phi-Deck transport, the total load procedure is reduced to a single action — turning on power. Less than \$600.

For further information contact The Digital Group, Inc., P.O. Box 6528, Denver, CO 80206; (303) 861-1686.

CIRCLE INQUIRY NO. 158

MFE's New 8-Bit Parallel Interface for its Model 250B Cassette Drive

MFE Computer Access Systems' Model 250B Digital Cassette Transport with 8 Bit PARALLEL I/O Board.



This provides "universal" I/O compatibility for Minicomputers, Microcomputers, and other 8 bit ASCII devices. I/O provides (8) INPUT lines, (8) OUTPUT lines, (8) CONTROL lines, and (5) INTERRUPT lines. Total power +6v and -12v. ANSI/ECMA compatible tapes, up to 32,000BPS transfer rate. 10-40ips R/W/Search, 80-120ips rewind. I/O is all TTL logic. The single unit price is \$325. OEM discounts are available.

For further information contact MFE, Keewaydin Drive, Salem, NH 03079; (603) 893-1921; TWX 710-366-1887; Telex 94-7477.

CIRCLE INQUIRY NO. 159

Introducing The First Professional Quality Modem In Kit Form...

The Pennywhistle 103

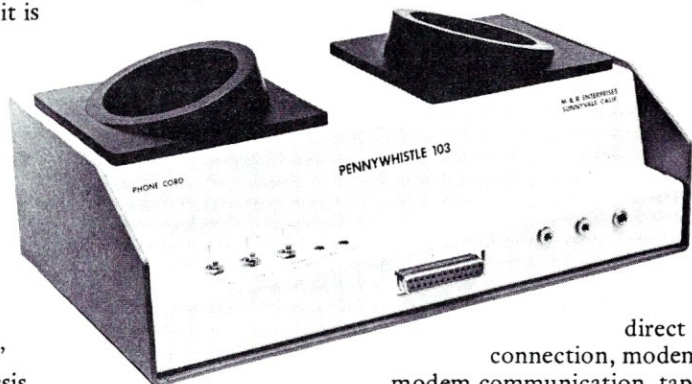
The Pennywhistle 103 Acoustic Coupler is the first professional quality modem available in kit form. The Pennywhistle may be used either as an acoustic coupler (with the telephone handset) or it may be wired directly into the telephone. In either case, the Pennywhistle will operate in both the half-duplex (unidirectional) or the full-duplex (bidirectional) modes.

The Pennywhistle 103 is capable of recording data to and from audio tape without critical speed requirements for the recorder and it is able to communicate directly with another modem and terminal for telephone "hamming" and communications for the deaf. In addition, it is free of critical adjustments and is built with non-precision, readily available parts.

One of the most significant problems associated with modems is that there is often difficulty in determining the difference between a signal of the proper frequency and one of its harmonics. The Pennywhistle 103, however, employs a *three-stage* active filter which prevents noise and harmonics from getting through.

The Pennywhistle kit includes everything needed for the entire unit. All electronic components mount on a 5" by 9" printed circuit board. The kit also includes all chassis parts, speakers, speaker grilles, muffs and line cord.

But just as important, the Pennywhistle is backed up with a complete documentation manual. This manual describes — in detail — what a modem is and how it works. All theory of operation discussions are keyed to a block diagram and schematic. This manual also contains a thorough set of assembly, test and adjustment instructions as well as directions for hooking the Pennywhistle up

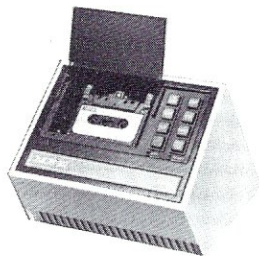


for direct wire connection, modem-to-modem communication, tape recorder connection and long distance use.

The Pennywhistle 103 modem kit is \$109.95 (plus \$2.50 for postage and handling) and is available from M&R Enterprises, P.O. Box 61011, Sunnyvale, Ca. 94088. California residents add 6% sales tax. Allow approximately four weeks for delivery.

MFE's Model 5000 Buffered Data Terminal System

MFE's Model 5000 Buffered Data Terminal is the only system in its market to use a micro-computer for control and efficiency. MFE's integration of the Intel 8080A Microprocessor controls the system's buffering, programmed high speed search, powerful editing, and full communications capabilities.



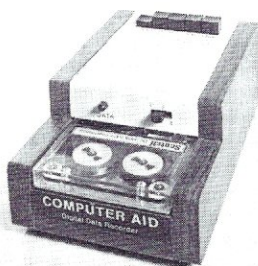
The Model 5000 single unit price is \$1995. Quantity pricing starts at five units.

For further information contact MFE, Keewaydin Drive, Salem, NH 03079; (603) 893-1921; TWX 710-366-1887; Telex 94-7477.

CIRCLE INQUIRY NO. 160

Recorder Model 3M1

Uses the 3M Data Cartridge type DC100A. This cartridge contains 140 feet of .150 tape and is the same cartridge used by H.P. and others.



Runs at 4800 baud NRZ, 2400 baud P.E. Tape speed adjustable, but nominally set at 5"/second. Maximum recommended flux density 1200 fcpi. Cartridge measures 2 1/8 by 3 1/4". This model is ultra compact, yet extremely capable. It is intended for word processing, mailing list use and other applications requiring the compact storage of data. Data location is by inter-record gaps and automatic file search. See Common Specs on other side. 2SIO (R) is not required for use, but is highly recommended for 8080 and Z80 users. 8080 Software listing provided.

For further information contact National Multiplex, 3474 Rand Ave., P.O. Box 268, South Plainfield, NJ 07080.

CIRCLE INQUIRY NO. 161

OEM Digital Cassette Transports

Memodyne also offers transports for the original equipment manufacturer. These units are capstan/pinch roller driven devices. The capstan is an extension of the shaft of a precision stepping motor. When the pinch roller is lowered (with the magnetic head assembly) the cassette tape is guided through in precise steps. The tape will only move when a clock pulse is given to the stepping motor. As many as 1600 precision steps per inch can be achieved with this method.

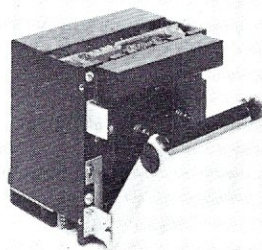
On write-only units a spring clutch assembly is connected to the stepping motor shaft and the take-up hub thus permitting the tape to be stepped through using only 60 to 80 mA. On standby only 10 to 20uA are used.

For further information contact Memodyne Corporation, 385 Elliot Street, Newton Upper Falls, MA 02164.

CIRCLE INQUIRY NO. 162

New CS-400 Digital Cassette Tape Transport

The CS-400 utilizes Braemar's recently announced CD-200 transport and provides the user with a compact ultra reliable data recording system at a reasonable cost. The system is engineered with the designer in mind and is ideal for microprocessor use. It is easy to implement, requires only one supply voltage (between 14 and 30 volts) and is totally TTL compatible. Operation is also feasible at voltages below 14 volts.



The CS-400 has a complete electronic package. It accepts and delivers serial digital data at TTL levels at an 8K baud rate. The unit operates at a nominal density of 800 BPI at 10 IPS, with other speeds and densities optional. Its CMOS circuitry assures reliable data and low power consumption.

For further information contact Braemar Computer Devices, Inc., 11950 Twelfth Avenue South, Burnsville, MN 55337; (612) 890-5135.

CIRCLE INQUIRY NO. 163

Viatron 2111 Microprocessor/Terminal

Two integral cassette tape decks for data storage.

Versatile hardwired programmable programs allow offline data manipulation.

Verification and correction features significantly reduce the number of errors that get online.



ASCII coded keyboard has features for insertion, deletion, cursor position select, upper and lower case alphanumeric.

Search feature, easily initiated, will automatically retrieve tape stored data. Once retrieved, data can be automatically transmitted or stored on the second tape, while simultaneously being displayed for verification.

Formatting is done by controlling output of one tape with formatting information stored on the other tape.

Function panel indicates microprocessor operations.

Rugged optical keyboard eliminates problems with switchbounce and missing characters.

Output is eight bit parallel ASCII.

For further information contact Verada 214, P.O. Box 438, Lowell, MA 01852; (617) 458-3077.

CIRCLE INQUIRY NO. 164

New Cassette for "Audio" Program Loaders Available

Using ordinary audio cassette recorders to store programs is a widely used method by serious home computerists. A problem with this approach is that ordinary cassettes have occasional bad spots that are quite tolerable for music, but cause loss of data. Switching to certified digital cassettes eliminates the bad spot problem, but often results are worse, because the nonlinear, saturating characteristics of digital tape causes intolerable distortion through the

audio circuits of the recorder. This dilemma has prompted the development of the LT-4800 cassette which is made specifically for storing digital information on audio tape recorders.

Each LT-4800 contains 150 feet of tape in a digital-quality enclosure, but has the linear response and high output of top grade audio tape. The tape is 100% certified to have no bad spots by the same general procedures and equipment used for digital tapes.

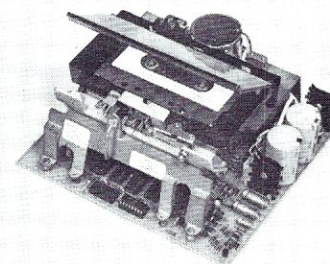
The prepaid price (including shipping and handling) is \$7.68 in lots of 10. A single cassette is \$13.75.

For further information contact William M. Kahn, Digital Laboratories, 600 Pleasant St., Watertown, MA 02172; (617) 924-1680.

CIRCLE INQUIRY NO. 165

Variable Speed Tape Transport Available at Low Cost for Micro Processors

The Triple I Division of The Economy Company of Oklahoma City is now offering a new variable speed model to its line of electronic cassette tape transport for under \$100. Features of the variable speed model include: four-motor control, remote control capabilities, fast start stop, less than 30 seconds rewind, AC or Battery operated and variable speeds (.4 to 10 IPS). Power requirements are only 7.0V DC at 600 MA average.



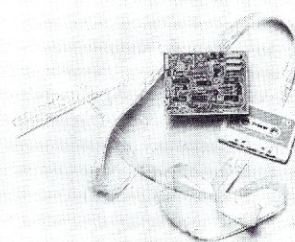
Options such as EOT/BOT sensing, record/play, read/write, electronics, cassette in place sensing, and others are available.

For further information contact The Economy Company, P.O. Box 25038, Oklahoma City, OK 73125.

CIRCLE INQUIRY NO. 166

Low Cost Audio Cassette/TTY/CRT Adapter for Micro Processors

Electronic Product Associates, Inc. recently announced the availability of a new, low-cost audio Cassette/TTY/CRT Adapter which allows any serial TTL or MOS output to simultaneously interface a low cost audio cassette player via frequency shift keying (Byte Standard) up to 300 Baud and to a standard RS232 CRT and a 20 mA current loop TTY.



The adapter also simultaneously decodes Byte Standard FSK data from low-cost audio cassette players and from 20 mA current loop TTY and RS232 CRT. Audio cassette information is decoded by a proprietary phase locked loop system developed by EPA which is said to be the most reliable method available for transferring digital data to and from low-cost audio cassette players. The model TCC3 is 4 1/2" x 3 1/4" (11 1/2 cm x 8 cm) and mounts piggy back on the EPA Micro-68 development computer. The TCC3 price is \$129.00 in singles, completely assembled and tested. Delivery

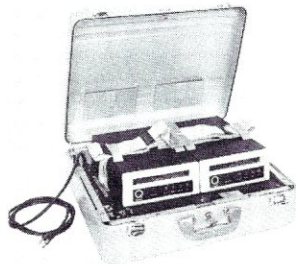
is from stock.

For further information contact EPA, 1157 Vega Street, San Diego, CA 92110; (714) 276-8911.

CIRCLE INQUIRY NO. 167

Portable Data Storage Unit

North Atlantic's Qantex Division announces the dual Model 2710 portable digital cartridge recorder, featuring a complete and autonomous data storage system that uses the 3M DC300A Data Cartridge as the tape storage medium.



Model 2710, with two drives, goes singly for less than \$3,900, complete with interface, formatter, and internal cables, plus a common power supply for both recorders. The unit is also offered as an OEM recorder with appreciable discounts for quantity purchases.

For further information contact North Atlantic Industries, Inc., Qantex Division, 200 Terminal Dr., Plainview, NY 11803; (516) 681-8350.

CIRCLE INQUIRY NO. 168

Recorder Model 3M3

Uses the 3M Data Cartridge, model DC300. This cartridge contains 300 feet of .250 tape in a sealed container. Records and plays at 9600 baud NRZ, 4800 baud P.E. Nominal speed 8" per second. Max. recommended flux density 1200 fcpi.



Using four tracks, you can store nearly 2 megabytes of data on a cartridge. Cartridge measures 4" by 6". Turns counter indicates tape position. Inter-record gap light gives more accurate position. 2SIO (R) is not required for use, but is highly recommended for 8080 and Z80 systems. 8080 Software Listing provided.

For further information contact National Multiplex Corp., 3474 Rand Ave., Box 288, South Plainfield, NJ 07080; (201) 561-3600; TWX 710-997-9530.

CIRCLE INQUIRY NO. 169

PAPER TAPE EQUIPMENT

Alphanumeric Printer

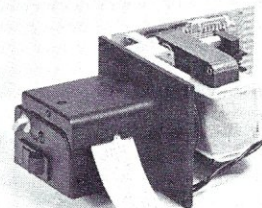
Printer employs dot matrix techniques with 7-wire dots and has 40-column capacity, 1.25 1/5 printing speed, and the ability to print large characters of variable density and shape, totally under software control.

For further information contact Ken Hidaka or Mike Niizu, C. Itoh Electronics, Inc., 5301 Beethoven St., Los Angeles, CA 90066; (213) 390-7778.

CIRCLE INQUIRY NO. 170

Paper Tape Reader Costs Only \$151 for Single Unit

A series of paper tape readers that read all standard 5, 6, 7 or 8-level tapes with no adjustments at 350 characters per second is announced by Addmaster Corporation. Known as the Model 640 "Data Loader" Series, they employ LED light sources and hermetically sealed phototransistors. Power requires 115VAC, 10 watts.



Outputs available are: Model 640-1, Schmidt triggered CMOS amplifiers and TTL-compatible drivers. Model 640-2, Schmidt triggered CMOS data amplifiers. Model 640-3, Phototransistors only (includes selected emitter resistors).

Price: Single unit to 49 pieces: \$151 (Model 640-3). DELIVERY: 2 weeks.

For further information contact Addmaster Corp., 416 Junipero Serra Drive, San Gabriel, CA 91776; (213) 285-1121.

CIRCLE INQUIRY NO. 171

KP-40, The "Naked Printer" Kit

For the hobbyist that is willing to trade three hours of his time to save money, MPI is introducing the \$179 Naked Printer Kit, consisting of a C. Itoh 7040 mechanism, paper holder, interface/power supply PC board and all electronic components.

The mechanism uses a 7 wire print head to pro-

Soroc plays Santa GIVE YOURSELF A CRT FOR CHRISTMAS

This will only happen once. Between now and Dec. 31st (for the late, late shoppers) you can purchase a CRT Terminal kit for \$849.00. On Jan. 1, 1977 the price becomes a realistic \$995.00.

But regardless of price, you won't find another CRT with these features under \$1000.

- ☐ 64 Character set, 960 Memory
- ☐ Block Cursor-total control
- ☐ RS-232-C interface

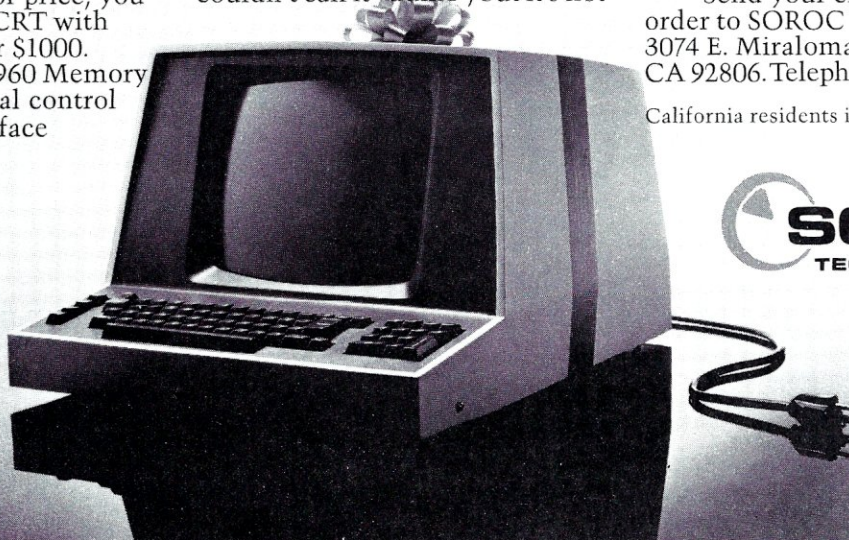
- ☐ 15 Data rates, switch selectable
- ☐ Half and full duplex transmission
- ☐ 79-key keyboard, with numeric pad
- ☐ Editing features-STANDARD

This new terminal is so packed with other features we couldn't call it "dumb", but it's not

intelligent either. So we call it smart. The model no. is IQ-120, and it's brought to you by SOROC Technology Inc., the same folks who used to design dumb terminals.

Send your check or money order to SOROC Technology Inc., 3074 E. Miraloma Ave., Anaheim, CA 92806. Telephone 714/630-2232.

California residents include 6% sales tax.
Terms: FOB origin.



SOROC
TECHNOLOGY, INC.

duce 5x7 impact dot matrix characters at up to 40 characters per line with a thrupt rate of 75 lines per minute. The Interface/Power Supply board provides a Ready/Acknowledge 8-bit parallel interface and power supplies required by the interface and print solenoid drive amplifiers. Direct software control of the individual print solenoids allows the generation of special character fonts and symbols. The character generation tables are located in the host processor memory, either ROM or RAM.

For further information contact Micro Peripherals, Inc., P.O. Box 22101, Salt Lake City, UT 84122; (801) 566-0201.

CIRCLE INQUIRY NO. 172

Matrix Printer

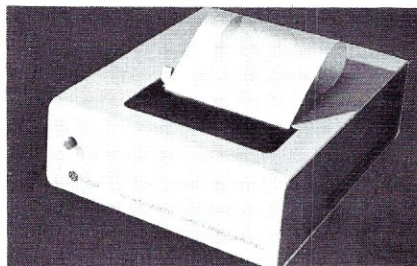
Applied Computing Technology, Inc. is introducing a new addition to their Series 900 Interactive Medium Speed Matrix Printer line. Now available is a plotter version of the Series 900 Printer, which allows a dot to be printed on any position on the paper with a horizontal resolution of 60 dots/inch and a vertical resolution of 72 dots/inch.

For further information contact ACT, 17961 Sky Park Circle, Irvine, CA 92707; (714) 557-9972.

CIRCLE INQUIRY NO. 173

Altair 7000 Graphics/Printer

The tremendous flexibility of the MITS Altair 7000 Graphics/Printer, which acts as a printer, plotter and graphics device, makes it one of the fastest and most economical methods of electrostatic printing.



The flexibility of the new Altair 7000 Graphics/Printer is due to eight print electrodes, driven directly by software, instead of the usual seven found in 5x7 matrix printers. Copies made from the printed output are actually more legible than copies of typed paper and can be made for about 1¢ per foot of electrosensitive paper.

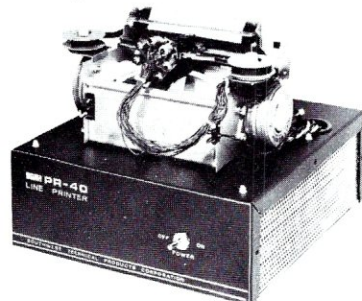
When the 7000 is used as a line printer, characters are generated using a 5x7 dot matrix. Altair BASIC supports three different sizes of character sets (each with upper and lower case) to produce line widths of 20, 40 and 80 characters in the four-inch wide printing area. The speed is 160 characters per second (80 characters per line) or 120 lines per minute. Different character sizes are selected with the CHR\$ function in BASIC.

For further information contact MITS, 2450 Alamo SE, Albuquerque, NM 87106; (505) 243-7821.

CIRCLE INQUIRY NO. 174

Alphanumeric Printer

The SWTPC PR-40 Printer kit is a low cost alphanumeric printer. The unit is a 5 x 7 dot matrix impact printer similar in operation to the well known Centronics printers.



It prints the 64 character upper case ASCII set with 40 characters/line at a rate of 75 lines/minute

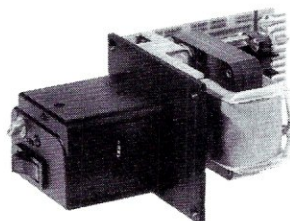
on standard 3 1/8" wide rolls of adding machine paper. One complete line is printed at a time from an internal forty character line buffer memory. Printing takes place either on receipt of a carriage return or automatically whenever the line buffer memory is filled.

For further information contact SWTPC, 219 W. Rhapsody, San Antonio, TX 78216.

CIRCLE INQUIRY NO. 175

Low Cost Paper Tape Reader Reads 350 Characters Per Second

A series of paper tape readers that read all standard 5, 6, 7 or 8-level tapes with no adjustments at 350 characters per second is announced by Addmaster Corporation. Known as the Model 640 "Data Loader" Series, it employs LED light sources and hermetically sealed phototransistors. Power required 115VAC, 10 watts.



Outputs available are: Model 640-1, Schmidt triggered CMOS amplifiers and TTL-compatible drivers. Model 640-2, Schmidt triggered CMOS data amplifiers. Model 640-3, phototransistors only (includes selected emitter resistors.)

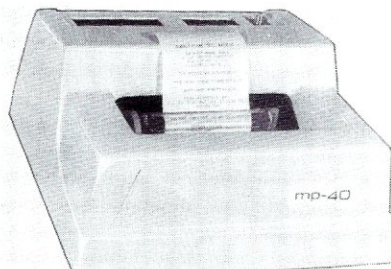
Price: Single unit to 49 pieces: \$151 (Model 640-3). Delivery: 2 weeks.

For further information contact: Addmaster Corp., 416 Junipero Serra Drive, San Gabriel, CA 91776; (213) 285-1121.

CIRCLE INQUIRY NO. 176

MP-40 Printer

The MP-40 is a low-cost impact printer designed for the small microsystem market.



The number of moving parts has been minimized to increase the reliability and reduce any maintenance time. It generates 5 x 7 dot matrix characters at a throughput rate of 75 lines per minute with a maximum print line capacity of 40 columns.

For further information contact MPI, P.O. Box 22101, Salt Lake City, UT 84122; (801) 566-0201

CIRCLE INQUIRY NO. 177

CP 110 Printer

The Model 110 is a desktop line printer that produces 80 columns of 5 x 7 dot matrix characters at 110 cps or 65 lpm. The impact head prints bidirectionally on 8 1/2" roll paper using a conventional teletype ribbon.

For further information contact Okidata Corp., 849 Ward Dr., Santa Barbara, CA 93111; (805) 964-3535.

CIRCLE INQUIRY NO. 178

6800 and 8080 Compatible

EPA has announced the availability of a new 40 column, dot-matrix impact printer, complete with drive electronics, character decoding and software driver prompts, and power supply.



Plastic cabinet interfaces directly with the 6800 and 8080 microprocessors.

For further information contact Electronic Product Associates, Inc., 1157 Vega St., San Diego, CA 92110; (714) 276-8911.

CIRCLE INQUIRY NO. 179

Data Logger

Memodyne Corporation of Newton, Massachusetts, announces a new series of inexpensive low power data loggers which generate cassette tapes for later analysis on Wang Laboratory's 2200 series of computers.



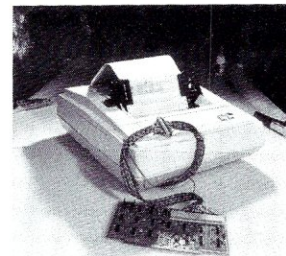
Designated the 200W series, these data loggers accept up to 16 channels of 0 to +10 volt analog signals, convert them to binary digital data, format this data and write it on standard Philips cassettes.

For further information contact Memodyne Corp., 385 Elliot St., Newton Upper Falls, MA 02164.

CIRCLE INQUIRY NO. 180

Altair 110 Line Printer

The Altair 110 Line Printer is a desktop line printer that produces 80 columns of 5 X 7 dot matrix characters at 110 cps (70 lines per minute).



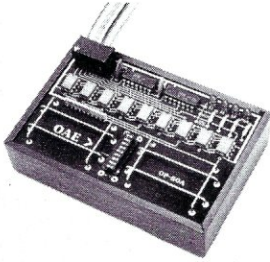
The impact dot matrix prints bidirectionally, using a conventional Teletype ribbon. The Altair 110 will print up to three copies of any item, plus the original.

For further information contact MITS, 2450 Alamo SE, Albuquerque, NM 87106.

CIRCLE INQUIRY NO. 181

Paper Tape Reader

The new OP-80A high speed paper tape reader from OAE has no moving parts and will read punched tape as fast as you can pull it through (0-5,000 c.p.s.).



The unit includes a precision optical sensor array, high speed data buffers, and all required handshake logic. It will interface directly with an 8 bit up I/O port, or can be connected across a UART allowing you to load programs through the TTY I/O port directly without software modifications.

For further information contact Oliver Audio Engineering, 1143 North Poinsettia Drive, Los Angeles, CA 90046; (213) 874-6463.

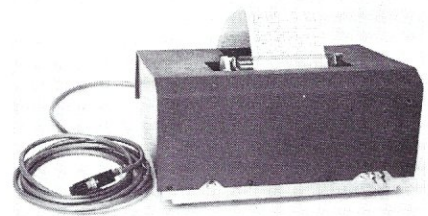
CIRCLE INQUIRY NO. 182



The three sizes utilize 3-7/16", 6", or 8-1/2" wide paper with a roll diameter of 3-5/16" to print on ordinary paper 1-5 copies without adjustment. Alternatively, fanfold can be accommodated. Advance can be either 6 to the inch by ratchet, or by programmable motor. The optional ribbon mechanism is specially designed for long life with flippable ribbon and two re-inking rollers for up to 500,000 lines of print without attention. Prices start at \$200 (unit list).

For further information contact Practical Automation, Inc., Trap Falls Road, Shelton, CT 06484; (203) 929-5381.

CIRCLE INQUIRY NO. 183



The IMSAI Printer interfaces to an 8-bit parallel output port. It is simple to program and to install as the printer is self-contained with case, cable, power supply, timing, control and character generation included.

For further information contact IMS Associates, Inc., 14860 Wicks Blvd., San Leandro, CA 94577; (415) 483-2093.

CIRCLE INQUIRY NO. 184

DMTP - 6 Series Alphanumeric Data Printers

This new family of printers is based on PA's proprietary miniature needle printer. Characters, a full ASCII set of 64, are formed by a 7 needle by 5 wide matrix forming a typical character .110" high x .08" wide. The head movement is under software control so both pitch - 8, 10, 12 to the inch - and character enhancement can be selected either line to line or within a line.

44Column Printer

IMSAI of San Leandro (Calif.) announces a new 44 column dot matrix printer designed for use with the IMSAI 8080 computer as well as many other computers. The IMSAI Printer is compact, efficient, and offers hard copy output at an affordable price. It will be available for immediate delivery priced at \$399 in kit and \$549 assembled.

DISCS

Altair/IMSAI Compatible Floppy Disc & Controller Kit or Assembled Form

The PAL FDC-1016 is a high quality-high performance-low cost response to the needs of serious users of Altair and IMSAI 8080 based microcomputers for floppy disc storage capabilities.

The single card floppy controller contains a direct memory access (DMA) interface to achieve op-

MERLIN

The Intelligent ASCII/Graphics Video Interface

MERLIN is the Altair/IMSAI compatible, programmable ASCII/Graphics video interface — with *sophistication*. Besides displaying 40 character by 20 lines of ASCII text, MERLIN is a high resolution graphics generator with Monitor/Editor intelligence as well. In graphics mode, memory can be displayed in 160H by 100V dot format. Monitor/Editor software allows memory modify, dumps, block copying, user breakpoints, cursor control, scrolling and many, many others (plug-in on-board ROMs available). There's a parallel keyboard port and a serial I/O port for cassette interfaces, joysticks, etc.

Interested . . . ? Write for more information.



- MERLIN: assembled, tested with User Manual (does not include Memory) \$349.00
- MERLIN: kit with IC sockets, User Manual and all parts except Memory \$249.00
- MBI: MERLIN's BASIC INTELLIGENCE: 256 X 8 RAM and 2K X 8 ROM containing Monitor/Editor \$ 39.95
- MEI, MERLIN's EXPANDED INTELLIGENCE: 2K X 8 ROM with more Monitor/Editor and graphics subroutines \$ 34.95
- MERLIN User Manual: over 100 pages of detailed hardware and software info (deductible from MERLIN order) . \$ 8.00

*Mass. Residents please add 5% sales tax



MiniTerm Associates

Box 268, Bedford, Mass. 01730

timum data exchange rates. The system is compatible with the IBM 3740 format.

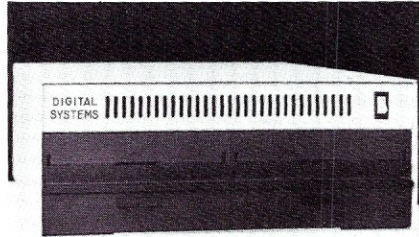
The cost? PAL FDC-1016K Controller card and components in kit form: \$395.00. Complete controller, FDC-1016K and GSI Model 110 disc drive (assembled): \$995.00.

For further information contact Processor Applications Ltd., 2801 East Valley View Ave., West Covina, CA 91792; (213) 965-8865.

CIRCLE INQUIRY NO. 185

Digital Systems Floppy Disk System

Digital Systems has available now a high quality Floppy Disk Controller for the superb Shugart drives. The Controller Board interfaces to the Altair/IMSAI bus with a single card. Data transfer is DMA at full memory speed.



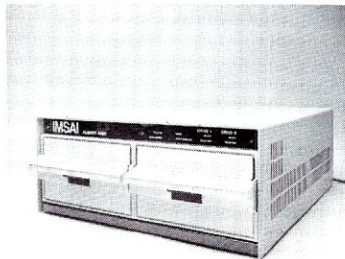
Another big plus for this system is the CP/M Operating System that comes complete with several languages. The CP/M software was written by the same author of Intel's PLM Compiler. The Altair/IMSAI power-on reset is used to boot-strap the complete operating system in less than two seconds. All boards are completely built and tested. IBM format is used. Single drive systems with interface card start at \$1165.00 for unit quantity. Complete software on a verified diskette with extensive manuals cost only \$70.00.

For further information contact Digital Systems, 1154 Dunsuir Pl., Livermore, CA 94550; (415) 443-4078. Add \$5.00 for hardware manual set (includes 4 manuals).

CIRCLE INQUIRY NO. 186

Floppy Disk for IMSAI 8080

IMSAI has recently announced the availability of a floppy disk drive with an intelligent interface/controller for use with the IMSAI 8080 computer.



The floppy disk has a capacity of 243K bytes using the IBM 3740 format. Interface/controller cards plug directly into the IMSAI 8080 or the Altair 8800.

For further information contact IMSAI, San Leandro, CA

CIRCLE INQUIRY NO. 187

FDOS-II Floppy Disk Operating System For iCOM Model FD360 Floppy Disk

The iCOM Floppy Disk Operating System (FDOS) works in conjunction with iCOM's Model FD360 Floppy Disk to provide several unique features designed for direct use with microcomputers and microprocessors. The FD360 Interface Kits are supplied ready to plug directly into the user's microcomputer. Or, the iCom Type 50 General Purpose Interface may be used to interface the FD360 to

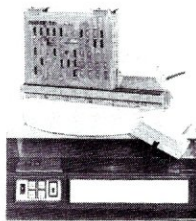
most microprocessors using only three latching I/O chips. In addition to direct hardware compatibility with the microcomputer, the FD360 is fully supported with a complete Flexible Disk Operating System (FDOS) which speeds program development time by a factor of 100 over a Teletype based system.

For further information contact iCOM Microperipherals, 6741 Variel Ave., Canoga Park, CA 91303; (213) 348-1391.

CIRCLE INQUIRY NO. 188

Disk Memory System

The new Series M3000 Disk Memory System is comprised of a moving head, rotating mass memory, controller, and all necessary cables for connection to the UNIBUS of the DEC PDP-11 computer family.



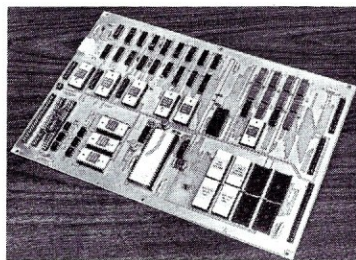
This Disk Memory System offers complete software, hardware, and media compatibility with the PDP-11.

For further information contact Computer Labs, Inc., 505 Edwardia Drive, Greensboro, NC 27409.

CIRCLE INQUIRY NO. 189

Floppy Disk Controllers

Scientific Micro Systems (SMS) has introduced a series of complete IBM-compatible floppy disk controller systems. The SMS Floppy Disk Micro-Controllers provide a common interface to currently available floppy disk drives (Orbis 76/77, Shugart 800, Pertec 400/500, Calcomp 140, Innovex 210).



A single floppy disk controller can interface up to four floppy disk drives connected in series.

For further information contact Scientific Micro Systems, 520 Clyde Ave., Mountain View, CA 94043.

CIRCLE INQUIRY NO. 190

Pertec Disc Drives

It took the world's largest independent manufacturer of multiple peripheral devices to combine the inherent benefits of flexible disk with an experienced knowledge of OEM needs. The result: a unique, unmatched product family — the Pertec family of flexible disk drives. The most versatile, compact, and reliable disk drives in the world. Compact size makes easy incorporation into your system.

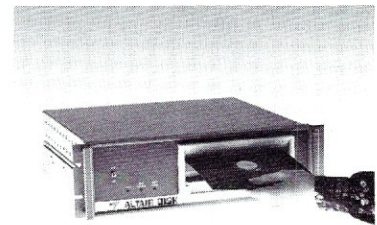
The FD400 provides you with a DC motor in a compact chassis. The FD5X0 and 511 provide double density capability. Up to 6.4 million bits (unformatted) of information may be reliably stored and retrieved on the FD5X0 and 511.

For further information contact Pertec, Peripheral Equipment Division, 9600 Irondale Ave., Chatsworth, CA 91311; (213) 882-0030, TWX 910-494-2093.

CIRCLE INQUIRY NO. 191

Altair Floppy Disk System

The Altair Floppy Disk System is a mass memory storage system designed by MITS engineers exclusively for the Altair 8800 series microcomputers.



The Altair Floppy Disk System consists of a disk controller unit, up to 16 disk drive units, DOS (Disk Operating System) and Disk Extended BASIC.

The disk controller unit is two Altair plug compatible circuit boards that fit inside the 8800 chassis. Data is transferred to and from the disk at 250,000 bits/second. The disk controller can control up to 16 Altair Disk Drives. It controls timing functions via hardware to allow for the most efficient use of software.

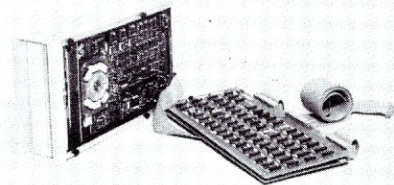
Altair Disk Extended BASIC provides the Altair 8800 series microcomputers with complete facility for reading or writing data files and for saving and loading program files.

For further information contact MITS, 2450 Alamo SE, Albuquerque, NM 87106; (505) 243-7821.

CIRCLE INQUIRY NO. 192

Low Cost OEM/Hobbyist-Oriented Microprocessor Floppy Disk Sub-System

Model FF-36, referred to as the Frugal Floppy™, employs the same elements as iCOM's field-proven FD360 system. However, by eliminating expensive cabinetry, power supply and system assembly labor, iCOM can offer the FF-36 for \$996 in small OEM quantities.



Basically, the FF-36 contains a Model CF360 Controller/Formatter, a Floppy Disk Drive with daisy chain capability, and all required connectors and cables. The unit can be supplied as a single (FF-36-1) or dual (FF-36-2) drive system.

For further information contact Terry Zimmerman, Vice President of Marketing, iCOM Inc., 6741 Variel Ave., Canoga Park, CA 91313; (213) 348-1391.

CIRCLE INQUIRY NO. 193

Disc Controller

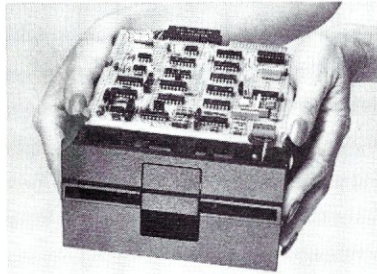
The Heurikon MLP-8065 disk controller provides IBM compatible data formatting and control for one to six individual drives. Designed to interface directly to Heurikon's MLP-8080 system bus, the MLP-8065 responds to all standard disk commands including read, write and seek.

For further information contact Heurikon Corp., 700 West Badger Rd., Madison, WI 53713; (608) 255-9075.

CIRCLE INQUIRY NO. 194

Low Priced Disk System for Altair/IMSAI's

The North Star MICRO-DISK SYSTEM is a complete, high performance floppy disk storage system for use with any Altair/IMSAI compatible computer. The introductory price of \$599 includes everything needed to turn on the computer and start loading or saving programs and accessing on-line data files. The disk unit is a compact version of the standard Shugart floppy.



The North Star controller is a single Altair/IMSAI compatible PC card which can control up to three drives. The \$599 introductory price covers: The North Star Controller, the Shugart mini-floppy drive (model SA-400), disk-to-controller cabling and connectors, two diskettes (one pre-loaded with the DOS software), complete documentation, limited warranty, and shipping.

For further information contact North Star Computers, Inc., 2465 Fourth Street, Berkeley, CA 94710; (415) 549-0858.

CIRCLE INQUIRY NO. 195

Wabash Floppy Diskettes

First quality, name brand diskettes at special prices for the personal computerist are available now from The Computer Corner. Both IBM-IMSAI diskettes, with one index hole, and Altair, Pertec, Shugart diskettes with 32 sector holes are in stock. Each diskette is individually enclosed in a jacket and housed in an attractive, durable envelope. Each box of ten includes color coded, pressure sensitive labels for easy identification.



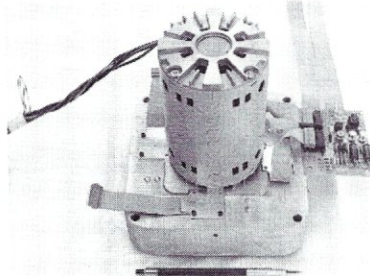
IBM-IMSAI Diskettes \$8.50 ea. 10 for \$70.00 including shipping. Altair-Pertec-Shugart Diskettes \$9.00 ea. 10 for \$75.00 including shipping.

For further information contact The Computer Corner, White Plains Mall, 200 Hamilton Ave., White Plains, NY 10601; (914) WH9-DATA.

CIRCLE INQUIRY NO. 196

Microdisc

BEE is offering a Microdisc kit including 16 data tracks and 2 spares, 10 K bytes per track — 160 K bytes expandable to over 1.0 megabytes, 16.5 is average access time, I/O is TTL, bit serial and a data transfer rate of 300 K bytes per second.



For further information contact Bargain Electronics Enterprises, 2018 Lomita Blvd., No. 1, Lomita, CA 90717; (213) 539-2260.

CIRCLE INQUIRY NO. 197

TERMINALS

Dumb Video Terminal Interfaces to Computer

The ADM-3 video terminal offers a standard 960-character display in 12 lines of upper case characters. It also is the only video terminal in its price class to make available an optional 24-line, 1960-character display.

The standard 59-key office-type keyboard per-

mits generation of the complete USASCII set. The ADM-3 displays upper case in high contrast characters in a standard 5 x 7 dot matrix.

For further information contact Marketing Department, Lear Siegler, Inc./EID, Data Products, 714 North Brookhurst St., Anaheim, CA 92803; (714) 774-1010.

CIRCLE INQUIRY NO. 198

Intecolor 8001

Intelligent Systems Corp. recently announced a major new low cost addition to its Intecolor 8000 line of Intelligent Color CRT terminal. Termed the Intecolor 8001, the new terminal will include an 8080 microprocessor, 8 color CRT readout, a 19" color shadow mask CR tube, keyboard, and the Intecolor 9 sector convergence system.

For further information contact Intelligent Systems Corp., 2405 Pine Forrest Dr., Norcross, GA 30071.

CIRCLE INQUIRY NO. 199

NEW COMPUTER STORE!!! COMPUTABLE PRICES!!!

COMPUTE THIS!!!

A PACKAGE DEAL

APPLE 1 Computer (with 4K RAM)
 regularly \$666.66
 Additional 4K RAM regularly 120.00
 Cassette Interface regularly 75.00

—ALSO—

Sanyo 9" Video Monitor
 regularly 185.00
 Datametics ASCII Keyboard
 regularly 100.00

ALL FOR \$999.00

All this regularly sells for. . . . \$1146.66
YOU SAVE \$147.00!

FOR MORE INFORMATION, CONTACT:



Sunshine COMPUTER CO

9 PALOMINO LANE
 CARSON, CALIF 90745
 Phone: (213) 830-8965

RICH TRAVIS

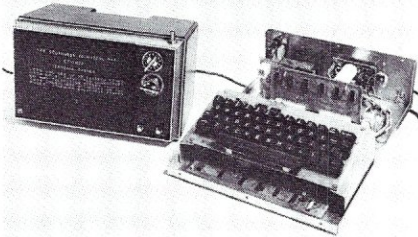
We also offer a full & complete mail order service for those of you who are outside the immediate area!

CIRCLE NO. 36 ON INQUIRY CARD

INTERFACE AGE 67

Low Cost Terminal System Kit

The CT-1024 Terminal System kit is a low cost, upper case, ASCII alphanumeric character generator designed to simultaneously display sixteen lines of 32 characters/line on a standard video monitor or slightly modified television set. It may be used to simply display messages and data on a TV screen, to communicate with either local or remote computer systems or to store and recover data from an audio cassette interface just to mention a few.



The terminal is sold in kit form only and may be purchased with the keyboard, cursor control board, interface and power supply for under \$300.00. This price does not include the chassis or display device.

For further information contact Southwest Technical Products Corporation, 219 W. Rhapsody, San Antonio, TX 78216; (512) 344-0241.

CIRCLE INQUIRY NO. 200

T-3000 Data Terminal Micro-Processor Controlled

Diablo Hytype II Mechanism: Graphic capability; High speed tabbing; Backward printing.

Attractively Styled Cover Containing: 8080 microprocessor; Memory; Logical circuitry; Power Supply.

Selectric Style Keyboard: Curved keyboard; Cupped F and J keys with typewriter touch; 10 key numeric pad with carriage return.

Control Functions: 1200 baud - RS-232 interface; Top of Form control; Scrolling platen.

Pricing: Quantity 1-10 \$2,875.00

For further information contact Multiterm Corp. 2612 Artesia Boulevard, Redondo Beach, CA 90277; (213) 376-6977.

CIRCLE INQUIRY NO. 201

The VT-4000 Video Computer Terminal

The VT-4000 Video Computer Terminal, from VIDEO TERMINAL TECHNOLOGY, is the only stand-alone video terminal on the market today to offer the features of a professional terminal at a hobbyist price. The VT-4000 displays 48 lines of 64 characters in a 5x7 matrix.



Other features include direct cursor addressing, up and down scrolling, selective clearing controls, selective video inversion, and all 32 control functions decoded and available for user strapping. The VT-4000 is easy to interface to any computer with its standard RS232C I/O and selectable BAUD rate from 110 to 9600. With its direct cursor addressing capability and your software, the VT-4000 can perform sophisticated text editing tasks (character/line correction, insertion, or deletion). Prices start at \$112.00 for the bare board set and run up to \$1000.00 for the complete assembled model.

For further information contact Video Terminal Technology, P.O. Box 60485, Sunnyvale, CA 94088; (408) 255-3001.

CIRCLE INQUIRY NO. 202

New Intelliterm™

INTELLITERM™ a low-cost intelligent TV terminal which displays 16 lines of 64 characters. Requiring only a TV monitor or modified TV receiver, INTELLITERM comes complete with a commercial grade keyboard in an enclosure and all required cables and connectors. INTELLITERM's logic board plugs into the backplane of the host computer and communicates with it via I/O instructions. No other interface boards are required and existing software can be run without modification.

A unique feature of INTELLITERM is the INTELLIKEY™. This key changes the function of the other keys so that pressing a key sends a complete BASIC command to the computer, not just a single letter. For example, pressing "A", with INTELLIKEY depressed, sends "PRINT" to the computer. Every BASIC command and key word can be sent automatically, using INTELLIKEY.

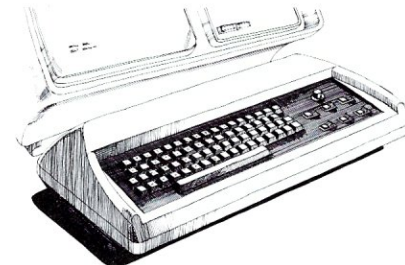
INTELLITERM is priced at \$395 in kit form and \$495 assembled.

For further information contact Computer Kits, Incorporated, 1044 University Ave., Berkeley, CA 94710; (415) 845-5300.

CIRCLE INQUIRY NO. 203

VT 100 Video Terminal

The VT 100 video terminal when connected to an ordinary television set allows the microcomputer user to communicate with most computers, especially the rising number of home personal computers.



The standard interface includes an RS232 connection as well as a 20 ma current loop.

A full typewriter-like keyboard with quality, easy-to-depress keys provides the standard ASCII character set including upper and lower case alphabets. Two key roll-over enhances ease of operation.

For further information contact Microcomputer Associates, Inc., 2589 Scott Boulevard, Santa Clara, CA 95050; (408) 247-8940.

CIRCLE INQUIRY NO. 204

Model BRB Video Terminal

The WINTEK BRB Video Terminal has a unit price of \$875. Specifications include a 9" monitor, 16 lines x 80 characters, upper case ASCII, all rates 110-9600, RS-232/ current loop, half/full duplex and composite video output.



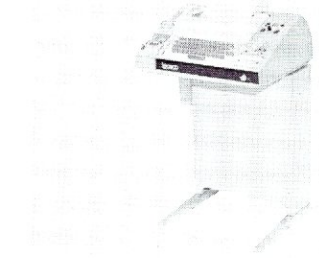
A board only model intended for OEM customers is also available at a price of \$345 in quantities of 100.

For further information contact Wintek Corporation 902 N. 9th Street, Lafayette, IN 47905; (317) 742-6802.

CIRCLE INQUIRY NO. 205

Model 33 Data Terminal

Model 33 terminals come in three configurations—ASR (Automatic Send/Receive) with paper tape punch and reader, KSR (Keyboard Send/Receive), and RO (Receive Only) terminals.



To accommodate easy communications with most computers and other business machines, all three configurations operate on eight level ASCII code and can move data at 100 wpm. For a more powerful, remote terminal capability with transmitting speeds of up to 120 cps, the Model 33 ASR/KSR can be used in combination with auxiliary storage units such as magnetic tape cassettes.

For further information contact Leasco Data Communications Corporation, 20030 Century Blvd., Germantown, MD 20767; (301) 428-0500.

CIRCLE INQUIRY NO. 206

Leasco L-30 Data Terminal

The L-30 features give it the capability to perform as a remote terminal, as a computer input/output device, or as a keyboard printer in any other related application.



The L-30 has an ANSI - standard, typewriter-style keyboard for the 128 character, ASCII character set. The unit prints ten characters per inch and 132 characters per line. The long-life 7 x 7 dot-matrix printing mechanism will print a six-part form with excellent character readability.

For further information contact Leasco Data Communications Corporation, 20030 Century Blvd., Germantown, MD 20767; (301) 428-0500.

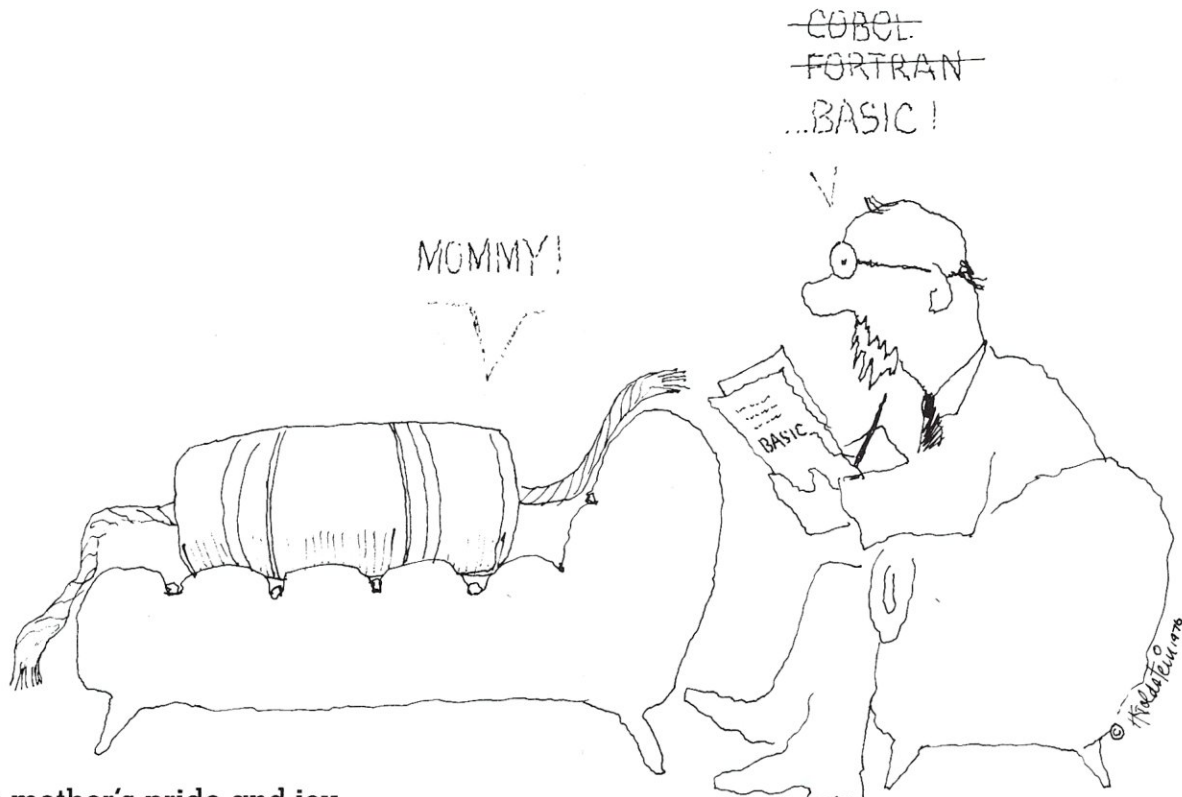
CIRCLE INQUIRY NO. 207

Model 1200 Data Terminal

Economy in handling high volume data traffic is offered by the Leasco Model 1200 terminals. The 120 cps print speed means lower costs for communication lines, computer connect time, and equipment. Model 1200 has three configurations . . . MSR (Magnetic Automatic Send/Receive) with magnetic tape cassette, KSR (Keyboard Send/Receive) and RO (Receive Only). All configurations communicate in ASCII code and can move data at 110, 300 or 1200 Baud, operator selectable.

For further information contact Leasco Data Communications Corporation, 20030 Century Blvd., Germantown, MD 20767; (301) 428-0500.

CIRCLE INQUIRY NO. 208



His mother's pride and joy.

Our computer doctor's mother is very proud of him these days. She always wanted him to have a profession. Now, he's a doctor. And one of the few in America trained in the specialty of personal computing. He limits his practice one hundred percent to equipment bought and sold here at the Computer Mart.

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A great benchside manner.

We carry most of the leading brands of personal computer products. And lots of helpful and informative software to go with them.

Should you hit a snag, just give our doctor a call. He'll labor long into the night to help you make your project feel better. In fact, he has made our special health care program for computers what it is today.

His benchside manner is something to behold!

Taking care of home computerists all over America.

If computer projects turn you on, check us out. The doctor and his entire staff will take real good care of your needs. One last thing! If you run into the doctor's mother, tell her you've heard of her son, the computer doctor. And just watch her light up!

We're taking care of home computerists all over America.
We are the Computer Mart, 625 West Katella Avenue,
No. 10, Orange, CA 92667 (714) 633-1222.



“...my son...
the computer
doctor”

Master charge and BankAmericard accepted
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Abacus Computer System Terminal

Abacus Computer Systems has a low cost, portable computer terminal that is suitable for microcomputers, computer evaluation kits, data entry systems and time sharing systems. This terminal weighs under 25 pounds with the integral keyboard, hardcopy printer and acoustical coupler.



The terminal is TTY compatible or it can be connected directly to the computer serial I/O port which has standard TTL voltages level. The acoustical coupler can be used to transmit and receive data over the phone lines. The coupler can also be used to load and store data on audio cassette tapes at speeds up to 300 bauds. The keyboard is ASCII encoded and consists of 51 alphanumeric solid state keys. The printer uses half inch strip, impact sensitive paper. The printer speed is 110 bauds.

For further information contact Abacus Computer Systems, 6315 Eunice Avenue, Los Angeles, CA 90042; (213) 666-1711.

CIRCLE INQUIRY NO. 209

Affordable Computer Terminal Act-I

MICRO-TERM INC.'s ACT-I (Affordable Computer Terminal) is a stand-alone video terminal which features an internally managed 1024 character memory arranged for display in 16 lines of 64 characters (standard ASCII upper case set), automatic scrolling, and selectable data rates of 110 to 9600 Baud. The handsome 53 key electronic keyboard employs gold crosspoint key switches for long term reliability and supports the full ASCII character set with two key rollover. A special PAGE key permits the display to be cleared locally.



The ACT-I comes fully assembled and tested. The wide variety of I/O options (included in the standard unit) allows interface to any processor that supports a serial I/O port. All oscillators are crystal controlled to insure a stable display and accurate data rates.

For further information contact Micro-Term Inc., P.O. Box 9387, St. Louis, MO 63117.

CIRCLE INQUIRY NO. 210

I/O CARDS

Low-Cost Accessory Board Increases Memory and Interface Capabilities of MMD-1 Microcomputer

A new accessory board model MMD-1/MI with extra RAM memory, Teletype interface, and audio

cassette interface. The MMD-1/MI simply plugs into the built in card edge connector on the MMD-1 and mounts on top of the unit.

A MMD-1/MI accessory board completely assembled and tested, sells for \$200.00. In kit form with all parts for assembly, the price is \$150.00. The MMD-1/MI has the following features:

- *2 K RAM memory capability (1K supplied)
- *Teletype interface (20 MA current loop)



*Paper Tape reader control for ASR33 Teletype writers

*Audio Cassette interface

*Sockets to accept up to 1 K PROM or ROM

The addition of the MMD-1/MI board to the basic MMD-1 Microcomputer increases the on board memory capacity to 2.5 K RAM and 1.5 K PROM or ROM.

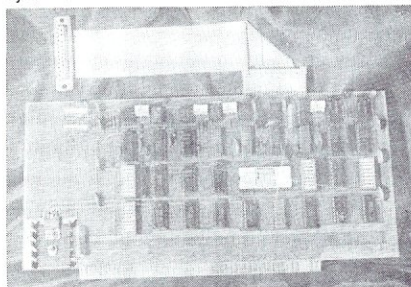
The Teletype interface and audio cassette interfaces allow easy and inexpensive data storage and retrieval.

For further information contact E&L Instruments Incorporated, 61 First Street, Derby, CT 06418; (203) 735-8774.

CIRCLE INQUIRY NO. 211

Dual Standard Cassette Interface

Affordable Computer Products is producing a new reliable cassette interface for the MITS/IMS systems.



It will handle both the Kansas City Byte Standard and the Manchester Biphase Synchronous Standard (commonly called Tarbell) without hardware modification. Tape leader timers and two cassette relays are on the board. Port addressing, baud rate, interrupt mode and vector are dipswitch or strapped header selectable as is mode of operation. Alignment and test out are made easy with accessible potentiometers and simple procedures as well as with good synchronization and test program tapes. Software on tape is available including a software monitor and Tiny Basic.

For further information contact Affordable Computer Products, 3400 El Camino Real, Santa Clara, CA 95051; (408) 249-5834.

CIRCLE INQUIRY NO. 212

Power-Start Auto-Load

POWER-START, an auto load board which plugs into an ALTAIR or IMSAI. Using POWER-START, BASIC, or any other language system, can be automatically loaded by just pressing RESET. POWER-START can be configured, by the user, to load from any device — Disk, cassette, or paper tape — and for any version or revision of the software being loaded.

POWER-START also simulates the front panel sense switches with on-board switches, so that terminal options can be set up only once. Additional circuitry allows the host computer to run without its front panel, an important feature for OEM applications.

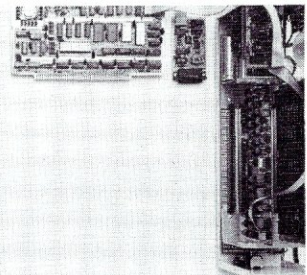
POWER-START is \$195 kit, \$295 assembled, or is available without the on-board ROM for \$145 and \$245, kit and assembled. This latter version is suitable for computers with existing ROM or PROM, since POWER-START can execute a loading program located anywhere in the computer's address space.

For further information contact Computer Kits, Inc., 1044 University Ave., Berkeley, CA 94710; (415) 845-5300.

CIRCLE INQUIRY NO. 213

Video Terminal Interface Altair/IMSAI/Polymorphic Compatible

Computer power is limited by the interface between machine and human. Communicating with your Intel 8080-based computer via the front panel or teletype is not enough. Only video display can match the speed and versatility of the computer. With the PolyMorphic System Video Terminal Interface, you can display a screenful of text or graphics, and update it in the blink of an eye.



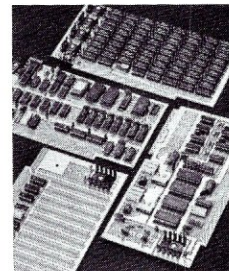
The POLY VTI includes a block of memory which it continuously scans and displays on the screen. The computer can read or write into this memory as fast as with any memory. The VTI also includes a keyboard input port. Any ASCII encoded keyboard using positive logic can be connected to this port.

For further information contact PolyMorphic Systems, 737 S. Kellogg, Goleta, CA 93017; (805) 967-2351.

CIRCLE INQUIRY NO. 214

Poly I/O Idea Board Altair/IMSAI/Polymorphic Compatible

The POLY 88 I/O Ideaboard enables you to build your special circuit without devoting time to the items common to all circuits. Address decoding provides eight strobe lines for four input and four output ports. Strobed buffers interface to data bus.



A jumper option allows memory-mapping output ports into the last 1/4K of memory space. A DIP switch makes address or port selection easy. The ideaboard also includes a 5V regulator and printed traces for adding more positive and negative voltages. Generous bypassing is provided. Wirewrap terminals are provided for bus lines and other important connections. Hole rows are drilled on three-tenths centers to give you maximum flexibility in placing chips on the Ideaboard.

For further information contact PolyMorphic Systems, 737 S. Kellogg, Goleta, CA 93017; (805) 967-2351.

CIRCLE INQUIRY NO. 215

EXPLORE THE FANTASTIC COMPUTER WORLD

AT THE BYTE SHOP of Pasadena. In a cheerful and comfortable environment, you can experiment and play with the many systems we have up and running. Ask us anything you need to know about computers. Let us help you design your new system. Join our classes and workshops to get your hardware and software working. Or just buy replacement ICs and tools. We'll bet what you're looking for is here. If it isn't we'll get it.



TRY THEM FOR YOURSELF

If you're in the dark about which computer is right for you, play with systems up and running every day at the BYTE SHOP. Experiment with games or other applications on computers we've hooked up to every type of peripheral. A tough choice becomes easier when you can sit down and compare computers for yourself.

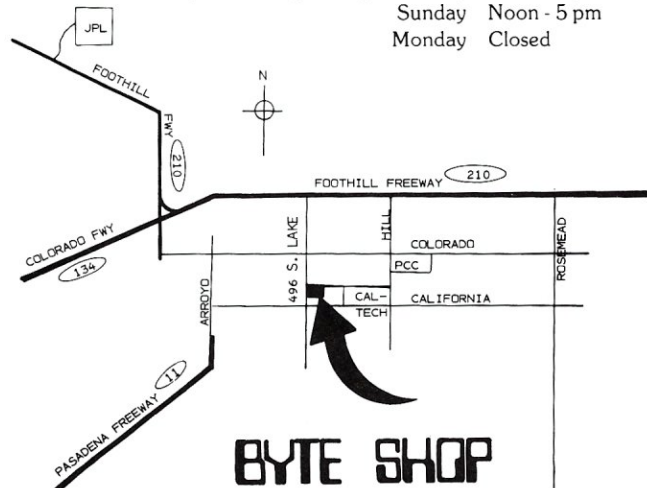
EVERYTHING FROM APPLE TO ZILOG

Whatever you've dreamed about for your system is here. Just a few of the computers at the BYTE SHOP are IMSAI 8080, Poly 88, SwTPC 6800, Apple Computer, TDL's ZPU, and more. Peripherals like Decwriter, iCOM's Frugal Floppy and the ADM-3 Terminal are on the shelf. Interfaces and accessories like Tarbell Cassette, boards from Cromemco, Processor Technology and many more are in stock. We can give you your dream system now and arrange a "Byte-a-Month" plan especially for your budget.

CLASSES AND WORKSHOPS

There's a class or workshop designed especially to provide what you need to feel like a well rounded computer person. Beginning programming classes, taught by enthusiastic experts, will help you talk with your computer. A hardware assembly workshop will give you some of the tricks of the electronics trade. A workshop for professionals will explore advanced program design techniques.

Open Tuesday through Saturday Noon - 9 pm
Sunday Noon - 5 pm
Monday Closed



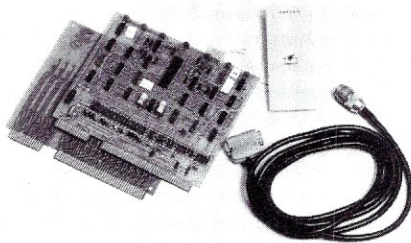
BYTE SHOP

496 South Lake Avenue
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Viatron Peripherals

Communications Adapter —

*Transforms 2111 output to eight bit serial ASCII (RS232C) to interface modems, teletype, other computers, second 2111, etc.



*Three Baud rate ranges available. Front panel select high/low. (247/110) (600/300) (1200/600)

*Built around standard Uart chip.

*Complete interface, plug-in board, new panel. No wiring, installed in a few minutes.

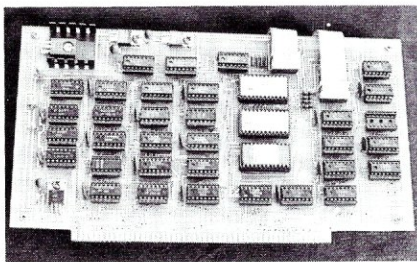
Price \$165.00

For further information contact Verada 214, P.O. Box 438, Lowell, MA 01852; (617) 458-3077.

CIRCLE INQUIRY NO. 216

Merlin Video Interface

This Intelligent Video Interface provides 40 characters by 20 lines ASCII or 160 horizontal by 100 vertical resolution graphics on a video monitor or modified TV.



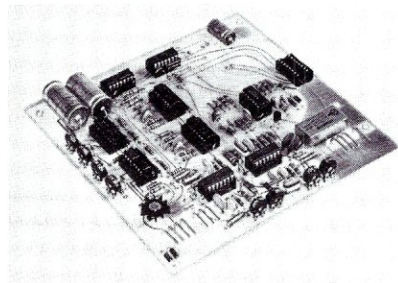
Two optional on board 2K x 8 masked ROMs provide sophisticated Monitor, Editor, Graphics, and I/O driver intelligence. A versatile DMA controller allows MERLIN to display any part of the computer memory and change the segment displayed with every screen refresh. MERLIN's parallel input port may be directly tied to most keyboards. If your system already has a teletype — MERLIN's intelligence can drive it as well. Available for Altair/MSAI systems and soon to be announced for SW6800 and Digital Group Computers.

For further information contact MiniTerm Associates, Inc., Box 268, Bedford, MA 01730

CIRCLE INQUIRY NO. 217

Digital Read/Write Amplifiers

Phi-Deck has introduced digital read/write amplifiers for its family of remote controlled cassette transports.



The one or two-channel amplifiers permit the user to utilize most any encoding methods commonly used. Phi-Deck presently is designing coding boards for micro processing systems applications.

The unit uses a Phillips certified data cassette,

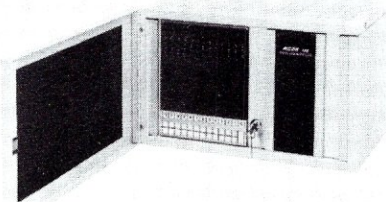
has a recording density of 0-1600 FRPI (flux reversals per inch), is 7/8" by 6 3/16" by 6 5/6" and weighs 6 ounces. Power requirements are +15 volts, -15 volts.

For further information contact Triple I, a division of The Economy Co., P.O. Box 25308, Oklahoma City, OK 73105; (405) 521-9000.

CIRCLE INQUIRY NO. 218

Micom Introduces New Multiplexor For DDS Links

A new low-cost, all digital time-division multiplexor designed especially for channelizing DDS links has been announced by Micom Systems Inc.



The Micom Model 720 Digital Data Multiplexor makes it possible for DDS links operating at 4800, 9600, or 56,000 bps to be split into two or more channels, synchronous or asynchronous.

For further information contact Roger Evans, Micom Systems Inc., 9551 Irontdale Ave., Chatsworth, CA 91311; (213) 882-6890 TWX 910-494-4910.

CIRCLE INQUIRY NO. 219

CRT 1 Interface

The CRT 1 contains the necessary electronics to display 512 characters on a video monitor. This unit is easily interfaced to Motorola Evaluation kit, SWTC, Cramer Kit and other 6800 microprocessor devices. The 64 character ASCII character set is displayed in a matrix of 32 characters by 16 lines. Each character is a matrix of 5 x 7 dots. To display a character a computer program simply moves the desired character into a memory position which is also the display refresh buffer. The refresh buffer is located in the high order 8K of memory. 512 bytes of static RAM is organized to be accessed by the CPU and CRT simultaneously without degrading the access time to the CPU.

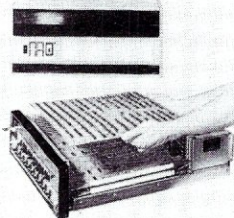
Output from the CRT 1 is a composite video signal. ETCHES for RF modulator have been left on the PC board (adjustable from channels 1-3) schematics supplied. Components have not been supplied since this circuit requires FCC testing and approval.

For further information contact Sphere Corp., 940 North 400 East, North Salt Lake, UT 84054; (801) 292-8466.

CIRCLE INQUIRY NO. 220

DC-220 Disc Controller Versions For Data General

Three new versions of the Western Peripherals DC-220 Disc Controller are designed to emulate specific Data General Systems.



These embedded, single-board controllers fit all NOVA and Eclipse computers as well as most Data General-emulating computers including the DCC-116, Keronix IDS-16 and MMI-600.

For further information contact Western Peripherals, Inc., 1100 Claudina Place, Anaheim, CA 92805; (714) 991-8700 TWX 910-591-1687.

CIRCLE INQUIRY NO. 221

Multi-Cassette Controller

RO-CHE Systems has just introduced a new Multi-Cassette Controller for the 8080 CPU microprocessors. Their "Magic Black Box" controls up to four cassette recorders with a Tarbell or MITS cassette interface board.



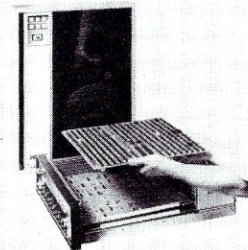
Using the four port Multi-Cassette Controller, (\$125.00 in a kit) and \$39.95 cassette recorders the micro-processor owner now has LARGE system capability at a small system cost.

For further information contact RO-CHE Systems, 7101 Mammoth Ave., Van Nuys, CA 91405.

CIRCLE INQUIRY NO. 222

Embedded Single-Board Tape Controller For Data General Nova Series Computers

A magnetic tape controller that combines PE and NRZ formats on a single board and fits a single slot in Data General NOVA computers has been developed by Western Peripherals Corporation, a new Anaheim based minicomputer peripherals firm.



The controller, available as the TC-120 Magnetic Tape Controller, includes the board and tape drive cabling. It is also available as the TS-120 which includes tape drives and cabling in a fully integrated and tested system.

For further information contact Western Peripherals Corp., 1100 Claudina Place, Anaheim, CA 92805; (714) 991-8700 TWX: 910-591-1687 Cable: Wesper.

CIRCLE INQUIRY NO. 223

Video Terminal Board

MICRO-TERM INC. has just recently made available a complete video terminal board. The board features all necessary serial I/O interfacing, and memory management for a 16 line by 64 character video display. The board accepts serial ASCII data (RS232C, TTL, or Current Loop; 110 to 9600 Baud) and provides the video out in the standard RS170 form. Parallel data supplied at the keyboard input is transmitted at rates from 110 to 9600 Baud. Can be used with any positive logic, TTL compatible KBD featuring a strobe. The power supply is included on the board.

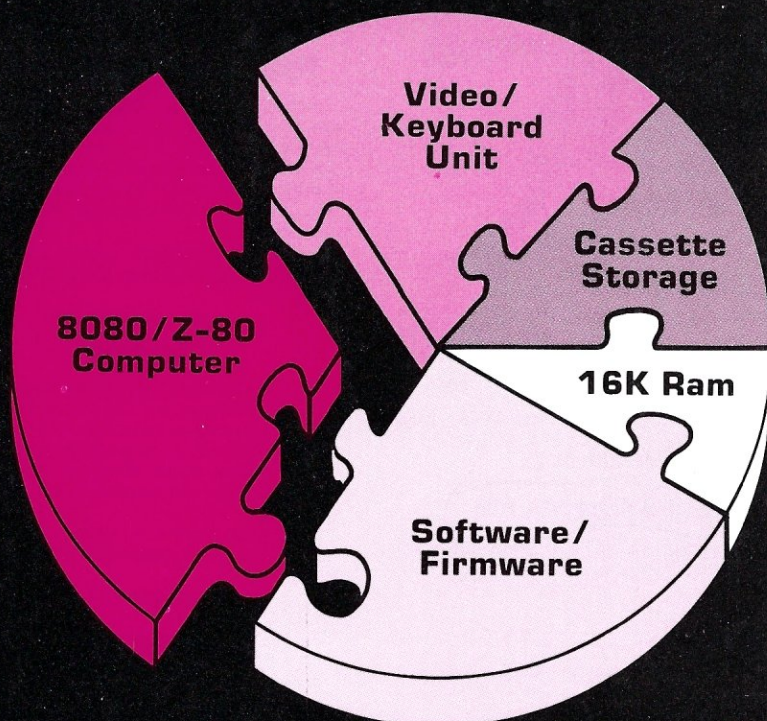
For further information contact Micro-Term Inc., P.O. Box 9387, St. Louis, MO 63117.

CIRCLE INQUIRY NO. 224

CF 360 Floppy Disk Controller

The iCOM Model CF360 Controller/Formatter is designed for use by OEM's in industrial, commer-

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Before the C.S.U. seal goes on each unit, it is tested, checked out, and burnt-in as a system. That's your guarantee of getting a computer that works when you first turn it on and keeps on working time after time.

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THE MUSIC BOARD — Only \$39.95.

Just in time for Xmas it's the ideal gift for yourself or a friend. The C.S.U. Music Board comes fully assembled, ready to plug-in and use. Your Xmas package comes GIFT WRAPPED and contains: 1) assembled music board, 2) alpha numeric music booklet, 3) programs to play Jingle Bells and other Xmas favorites, and 4) documentation and instructions for writing your own music. The C.S.U. Music Board comes with it's own speaker or you can use it's phono plug to drive your stereo. Don't be a SCROUGE!!! Treat yourself to a musically Merry Xmas that you'll enjoy the whole year long. Order yours today — or let your wife get it for you! **Just \$39.95.**

+ — × ÷ + — × ÷ + — × ÷ + —

NEW! NEW! NEW! NEW! Hardware Floating Point Board.

High speed BCD add, subtract (20 us), multiply, divide (100 us) up to 14 digits of precision. Comes with powerful 8K Basic (strings of any length, user defined functions, formatted output capability), to help you use it to it's full potential.

Assembled \$499. Unassembled \$359.

C.S.U. System Special #1

I-8080, 22 slot motherboard with 12-100 pin connectors, 16K fast RAM, MIO Board (1-SIO, 2-PIO, Byte/Tarbell Cassette), Poly 64 Character Video Interface, and enclosed ASC II Keyboard.

Assembled \$2602. Unassembled \$1890.

C.S.U. System Special #2

Poly 88 (filled with 100 pin connectors), 64 Character Video, 16K RAM, ROM Operating System, Byte Cassette, 1-SIO Port, and ASC II Encoded Keyboard in an attractive case. Turn it on, its ready to use.

Assembled \$1839. Unassembled \$1495.

C.S.U. System Special #3

Same as system #1, but with super ZPU board, 24 x 80 CRT, and PROM Operating System on Byte Saver PROM Programmer (replacing C.P.U., Poly V.T.I. and Keyboard).

Assembled \$3932. Unassembled \$2865.

Systems come complete with Cables, Connectors, Books, and Documentation.

High resolution 12" T.V./Monitor with Connective Cables — \$150. Special Cassette Recorder with Cables and Low Noise Cassette — \$75.

cial, and development applications. It is the same controller used in the iCOM FD360 series Floppy Disk System.

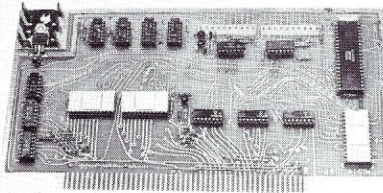
The CF360 can accommodate from one to four floppy disk drives and includes a TTL compatible general purpose interface.

For further information contact iCOM, 6741 Varie Ave., Canoga Park, CA 91303; (213) 348-1391.

CIRCLE INQUIRY NO. 225

Dual Input/Output Board With ROM

This 2SIO (R) board enables you to turn on your computer and go. No more Bootstrapping.



The Terminal I/O port has ROM programs for LOAD, DUMP and GoTo. The tape I/O port has ROM programs for formatting tape files, searches for files by name, paper tape read and punch, word processing and complete software control of cassette and cartridge tape units. When used with the 3M1 and 3M3 cartridge units you have keyboard or call control of rewind, fast forward, record, play and stop. Price of 2SIO(R) I/O Board with 1 ROM for NRZ Cassettes, Kit Price, \$139.95. Wired & Tested, \$169.95.

For further information contact National Multiplex Corp., 3474 Rand Ave., P.O. Box 228, S. Plainfield, N.J. 07080.

CIRCLE INQUIRY NO. 226

10-1 Input/Output, and Universal Board

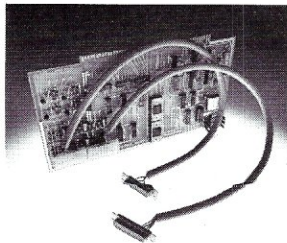
The I/O portion of the board is committed to provide one 8-bit parallel input port and one 8-bit parallel output port. The two ports use common address decoding logic and have the same address. This address is jumper selectable and can be any address from 0 to 254. Address 255 is used by the 8800 for the front panel sense switch input port. Pads for 40 uncommitted sockets are provided. Plug compatible with Altair 8800.

For further information contact Mikos, 419 Portofino Dr., San Carlos, CA 94070.

CIRCLE INQUIRY NO. 227

Parallel Input/Output

The 88-4PIO is capable of handling up to four ports on one plug-in card. Each port contains sixteen data lines.



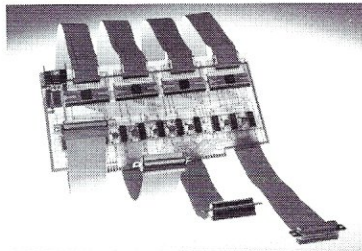
Each line can be initialized as input or output to interface a terminal (8 lines in, 8 lines out). All data lines are fully TTL compatible. Eight of the 16 lines are capable of directly driving the base of a transistor switch (1.5 v at 1 ma).

For further information contact MITS, 2450 Alamo SE, Albuquerque, NM 87106.

CIRCLE INQUIRY NO. 228

Serial Interface

The 88-2SIO provides five signal/control lines per port. Two ports are available.



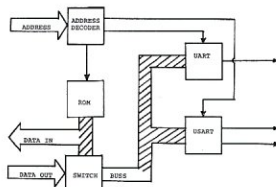
The five signal/control lines include the following instructions: Transmit Data; Receive Data; Data Carrier Detect; Clear to Send; Request to Send. These instructions allow for maximum utilization of sophisticated terminals.

For further information contact MITS, 2450 Alamo SE, Albuquerque, NM 87106.

CIRCLE INQUIRY NO. 229

8080 I/O Board with ROM

National Multiplex is offering a new Turn-key I/O Board for 8080 microprocessors.



All bootstraps, loads, dumps, and edits are in a 512 byte ROM on the I/O board. Utilizes a UART to interface with a terminal and a USART to interface with one or two cassettes.

For further information contact National Multiplex Corp., 3474 Rand Ave., Box 228, So. Plainfield, NJ 07080; (201) 561-3600.

CIRCLE INQUIRY NO. 230

AMI 6800

The AMI S6800 Prototyping Board is a single PCB, hardware/software prototyping system. It allows system development using a functionally compatible system and reduced development time. With this board, the basic 6800 family parts can be evaluated. It can also serve as a general purpose microcomputer for low volume systems to which the user can add I/O and memory.

For further information contact American Microsystems, Inc., 3800 Homestead Road, Santa Clara, CA 95051.

CIRCLE INQUIRY NO. 231

Universal Breadboarding Elements with Solderless Plug-in Tie Points

The AP Super-Strips combine a power/signal distribution system with a matrix of 128 terminals, each with 5 tie points. The distribution system consists of eight buses, each individual bus consisting of a line of 25 tie points. All tie points are the solderless, plug-in type of the same design used on AP Terminal Strips and AP Distribution Strips.

For further information contact AP Products, P.O. Box 110Q, Dept. 1, Palmsville, OH 44077.

CIRCLE INQUIRY NO. 232

Microprocessor Board

The first Wire-Wrap socket board designed especially for use with the Motorola M6800 microprocessor unit is available from Cambion. The pre-wired board is designed to save many man hours in the interconnection of the microprocessor eval-

uation kit and subsequent evaluation of the M6800.

For further information contact Cambridge Thermionic Corporation, 445 Concord Ave., Cambridge, MA 02138.

CIRCLE INQUIRY NO.

Digital Group Standard Mother Board

Mother boards from Digital Group, Inc., come without connectors. Each system board you buy has the connectors it requires to plug into the mother board. The Standard Mother will support up to 26K of memory and 16 input ports and 16 output ports. In addition, it will support a TVC and a CPU of your choice.

For further information contact Digital Group, Inc., P.O. Box 6528, Denver, CO 80206; (303) 861-1686.

CIRCLE INQUIRY NO. 233

Mini-Mother

The Digital Group Mini-Mother board will support 10K of memory and one I/O card and a TVC. You can also plug in one of three CPU's now available. The connectors come with the cards that plug into the mother board. Wirewrap connectors are used so that you can wirewrap to the underside of the board.

For further information contact Digital Group, Inc., P.O. Box 6528, Denver, Co 80206; (303) 861-1686.

CIRCLE INQUIRY NO. 234

CPU-TVC Boards

6800 CPU board also has 2K of RAM onboard. It has DMA capability, crystal controlled clock, bootstrap loader in PROM, and interchangeability with our other two CPU cards.

The TVC board is a combination of a video interface on the left and a cassette interface on the right. The video interface supports 512 characters on a standard monitor or modified T.V. set. The cassette interface is used in conjunction with any reasonable audio cassette tape player.

For further information contact Digital Group Inc., P.O. Box 6528, Denver, CO 80206; (303) 861-1686.

CIRCLE INQUIRY NO. 235

CPU-I/O Boards

The 6502 CPU board includes such features as 2K of RAM, DMA capability, crystal controlled clock, bootstrap loader for cassette on a 1702 PROM and single stepping capability. The 6502 and our other two CPU's will plug into our mother boards.

8080 CPU board has 2K of RAM onboard, single stepping, DMA capability, crystal controlled clock, 1702 PROM programmed for bootstrap load and uses the 8224, and 8228 support chips.

The I/O board provides four input ports and four output ports. The output ports are latched and the addressing for the ports will accommodate memory mapped I/O or the scheme used by the 8080 CPU.

For further information contact Digital Group, Inc., P.O. Box 6528, Denver, CO 80206; (303) 861-1686.

CIRCLE INQUIRY NO. 236

10-2 Input/Output, PROM, and Universal Board

I/O interface for the Altair 8800. Two I/O ports committed, pads provided for three additional ports. Other pad to facilitate wiring for a UART, EPROMS, etc. Instructions include information for several wiring options.

For further information contact Mikos, 419 Portofino Dr., San Carlos, CA 94070.

CIRCLE INQUIRY NO. 237

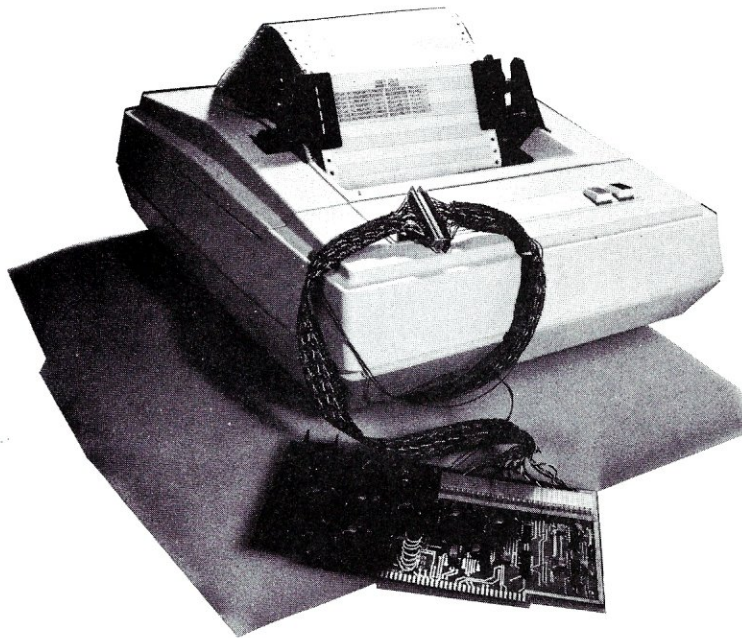
Mother Board

Altair 8800 compatible mother board made of heavy gauge glass board.

For further information contact Mikos, 419 Portofino Dr., San Carlos, CA 94070.

CIRCLE INQUIRY NO. 238

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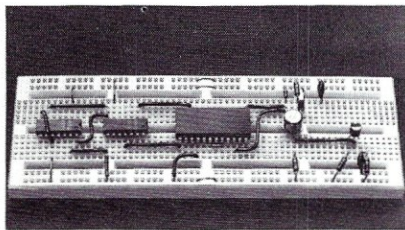
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A P Products, Inc. Line of Solderless Breadboards

A P Strips provide a low-cost alternative for the circuit builder who enjoys the speed, ease and versatility of solderless breadboarding but doesn't need the larger-scale capabilities of an ACE solderless breadboard. A P Strips also make a convenient add-on to any ACE to increase its capabilities.



ACE, Super Strips, Terminal Strips, and Distribution Strips are available from leading electronics distributors or direct from the factory.

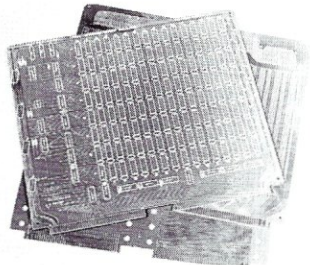
For further information contact Ken Braund, Product Marketing Manager, A P Products Inc., Box 110P, Painesville, OH 44077; (216) 354-2101.

CIRCLE INQUIRY NO. 239

Universal Cards

Davis Laboratories announces the first three offerings in a series of boards for the computer professional and/or Hobbyist. Boards are size and pinout compatible with the AMI Prototyping Board. Presently available are:

1. Universal Board-5400 + holes to build your own interface. Accepts any IC or module with 0.1" pin centers and greater than 0.2" row centers. Holds 94 16 pin IC's or can be modified to hold 188. Vcc and GND are distributed. Uses two 86 pin edge connectors, two 50 pin and one 20 pin flat cable connectors and one RS232 connector.
2. 16K Static RAM Board-uses 2102's or equivalent. Can be configured 16K x 8 or 8K x 16 for flexibility. All necessary timing done on board.
3. 6 Slot Mother Board-to put the other boards together.



Bare Boards: UNIVERSAL-\$90, 16K RAM-\$70, 6 SLOT MOTHER-\$25.

For further information contact Davis Laboratories, Box 2787, Santa Clara, CA 95051.

CIRCLE INQUIRY NO. 240

KB-1 Universal Kluge Board

Matches MB-1 memory board in shape and edge connector placement. Has provisions for two additional 22-pin edge connector at the top of the board. Main edge connector is 86-pin. 156" center.

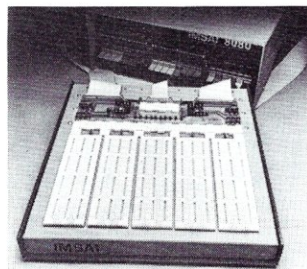
For further information contact Mikos, 419 Portofino Dr., San Carlos, CA 94070.

CIRCLE INQUIRY NO. 241

Intelligent Breadboard

New IMSAI Intelligent Breadboard System is a powerful experimental and educational tool for analyzing the trade-offs between hardware and

software implemented circuits. Ideal for implementing and testing digital logic circuits with program interaction and computer control.



The Breadboard console connects directly to an IMSAI 8080 computer. Provides direct access to the computer's bus lines for address, data, control and power, and to 48 lines of programmable TTL I/O. Supplied with power regulators, LED level indicators, I/O connectors, and space for up to 40 16-pin IC plug-in packages.

For further information contact IMS Associates, Inc., 14860 Wicks Blvd., San Leandro, CA 94577.

CIRCLE INQUIRY NO. 242

Low-Cost Accessory Board Increases Memory and Interface Capabilities of MMD-1 Microcomputer

A new accessory board model MMD-1/MI with extra RAM memory, Teletype interface, and audio cassette interface is now available from E & L Instruments and from all E & L Instruments stocking representatives.



The MMD-1/MI simply plugs into the built in card edge connector on the MMD-1 and mounts on top of the unit.

An MMD-1/MI accessory board completely assembled and tested, sells for \$200.00 in kit form with all parts for assembly, the price is \$150.00. The MMD-1/MI has the following features: 2K RAM memory capability (1K supplied); Teletype interface (20 MA current loop); Paper tape reader control for ASR33 Teletypewriters; Audio Cassette interface; and, Sockets to accept up to 1K PROM or ROM.

The addition of the MMD-1/MI board to the basic MMD-1 Microcomputer increases the on board memory capacity to 2.5K RAM and 1.5 K PROM or ROM.

The Teletype interface and audio cassette interfaces allow easy and inexpensive data storage and retrieval.

For further information contact E & L Instruments Incorporated, 61 First St., Derby, CT 06418; (203) 735-8774.

CIRCLE INQUIRY NO. 243

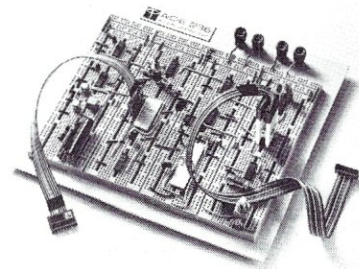
Solderless Bread Board

From the originators of the solderless, plug-in breadboarding concept comes another major price/performance breakthrough.

The ACE series of breadboards incorporates state-of-the-art techniques in design and fabrication to yield a circuit-building system with unparalleled flexibility and reliability.

Flexible and reliable might say it all . . . but add

economical and the result is unbeatable. The ACE line affords the user a cost-per-DIP relationship that is lower than any comparable product on the market today.



The ACE design configuration integrates a voltage distribution system with the basic circuit-building matrix. All models incorporate the A P Products laboratory-proven multi-tie-point terminal design. Additionally, five-way binding posts provide the interface for connections from the power supply to the ACE.

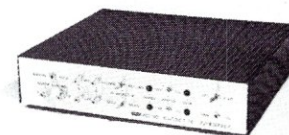
The tie-point terminal material is non-corrosive nickel-silver while the dielectric material is acetal copolymer. The base, which also serves as a ground plane, is fabricated from aluminum and is anodized for surface protection. Rubber feet are provided to prevent sliding.

For further information contact Sharp Advertising, Inc., 24500 Chagrin Blvd., Cleveland, OH 44122; (216) 464-3636

CIRCLE INQUIRY NO. 244

SWTPC Audio Cassette Interface

The SWTPC AC-30 Audio Cassette Interface kit is available for Computer and/or Terminal cassette tape program/data storage.



The unit will work with both terminal and computer systems interfaced RS-232 serially with UART type circuitry using accessible 16X 300 baud clocks.

For further information contact SWTPC, 219 W. Rhapsody, San Antonio, TX 78216.

CIRCLE INQUIRY NO. 245

Cassette Recorder "Breadboard" Offers Quick Interface to Microprocessor and Mini Systems

A Philips Cassette "breadboard" package consisting of the Model 763 Transport, all electronic circuitry, power supplies, control switches and convenient in/out connections for direct interfacing into computer systems and terminals is being offered by Memodyne Corp.



For further information contact Memodyne Corp., 375 Elliott St., Newton Upper Falls, MA 02164.

CIRCLE INQUIRY NO. 246

Interfacing the Hand Calculator With Memodyne Digital Cassette Recorders

Memodyne offers compact and simple digital cassette recorders distinguished by their incremental recording operation permitting a high density of information with very low power consumption.



Systems are available having 8 to 40 inputs in binary form, and up to 16 multiplexed analog inputs.

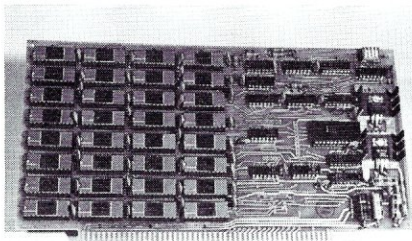
For further information contact Memodyne at 369 Elliot St., Newton Upper Falls, MA 02164; (617) 527-6600.

CIRCLE INQUIRY NO. 247

MEMORY CARDS

Altair 16K Static Memory Board (88-16MCS)

The Altair 16K Static Memory Board not only offers the advantage of low power consumption and extremely fast access time but also eliminates the need for additional refresh logic common to dynamic memories.



One Altair 16K Static board draws less current than any 8800 compatible 4K board. The maximum access time of the Altair 16K Static board is 215 nanoseconds. With such fast access time, there are no wait states.

The Altair 16K Static board includes a DIP switch for board address selection. Sockets are also provided for all RAM ICs.

For further information contact MITS, 2450 Alamo SE, Albuquerque, NM 87106; (505) 243-7821.

CIRCLE INQUIRY NO. 248

Low Cost 4K RAM Board

Board can be plugged in forwards or backwards — full address and data bus high impedance buffering. 4½ x 6" card with easy to use standard 44 pin connector. Built for 2102 to power 450 nono-second rams. Very high quality board plated thru holes and gold plated connector. Smallest and lowest priced 4K board available.

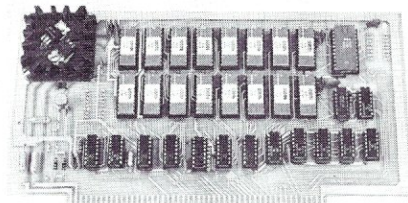
Board, rams, capacitors and documentation \$79.95.

For further information contact Kathryn Atwood Enterprises, P.O. Box 5203, Orange, CA 92667.

CIRCLE INQUIRY NO. 249

8K Low Power Static Memory

The 8KM is an Exceptionally Low Power 8K Static Memory from Electronic Control Technology which is plug-in compatible with the ALTAIR/IMSAI bus. It requires only a fraction of the power required by other "low power" memory boards. Less power also means less heat.



The memory IC's utilized are 4K static N-MOS RAM's with an access time of 215 nS. No wait or refresh states are required. Bus loading is only 1 low power TTL load per line used. All signals to MOS devices are buffered by low power TTL to prevent damage by static at the edge connector. The PC board has plated through holes and gold over nickel plated fingers. Low profile sockets are provided for all IC's.

Prices are as follows: 8KM kit, \$295.00; 8KM wired & tested, \$375.00; shipping & handling, \$2.00.

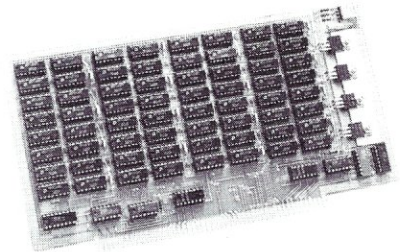
For further information contact Electronic Control Technology, P.O. Box 6, Union, NJ 07083.

CIRCLE INQUIRY NO. 250

Vector Graphic's 8 K Baby!

Compatible with Altair and IMSAI Mothers, this pre-tested 8 K Static Memory Board has buffered address and data out lines, a memory protect, no wait states, access time of 450 ns, low power consumption of only 1.3 Amps, output disable feature,

and a DIP switch located on the upper edge of the board which allows address change without removing the board from the computer.



The printed circuit board is of aerospace quality and solder masked on both sides. The 8 K Baby provides the most desired features in a high quality, low power product with a low price.

For further information contact Vector Graphic, Inc., P.O. Box 4784, Thousand Oaks, CA 91359; (213) 889-9809.

CIRCLE INQUIRY NO. 251

4K/8K Static Memory Expansion Modules KIM-2 and KIM-3

The KIM-2 and KIM-3 are memory expansion modules designed for use with systems using the KIM-1 microcomputer module. Both modules are completely assembled and tested. High speed, low power static memory integrated circuits are used - no memory slow down or refresh cycles are required. An on-board regulator allows system operation from a +8 volt unregulated power supply. Switches on the board allow the boards to be placed at any 4K (KIM-2) or 8K (KIM-3) boundary in the system memory space. Complete documentation is provided for board installation, checkout, and operation. Schematics and theory of operation are also provided. A single KIM-2 or KIM-3 can be wired directly to a KIM-1 module. System ex-

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Z80 Processor Board	\$234.95
4A-4 RAM Board	\$119.95
8K Low Power Fast	249.95
16K Low Power Fast	499.95

When Purchased with 8080



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LEAR-SIEGLER MODEL ADM-3

CHARACTER GENERATION

5 × 7 dot matrix.

DISPLAY FORMAT

Standard: 1920 characters, displayed in 24 lines of 80 characters per line.

CHARACTER SET

Standard: 64 ASCII characters, displayed as upper case, plus punctuation and control.

COMMUNICATION RATES

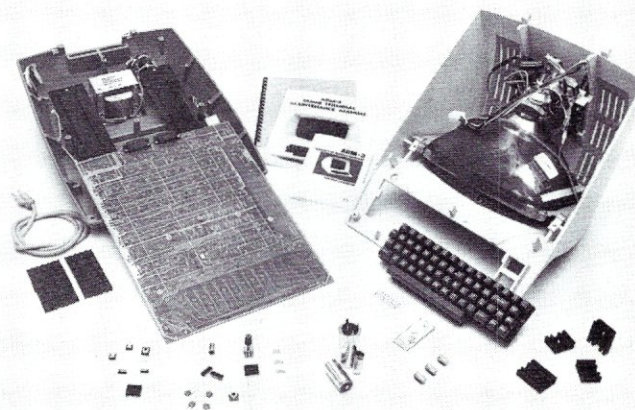
75, 110, 150, 300, 600, 1200, 1800, 2400, 4800, 9600, 19,200 baud (switch selectable).

COMPUTER INTERFACES

EIA standard RS232C and 20 mA current-loop (switch selectable).

DATA ENTRY

New data enters on bottom line of screen; line feed causes upward scrolling of entire display with top-of-page overflow. Automatic new line switch selectable, end-of-line audible tone.

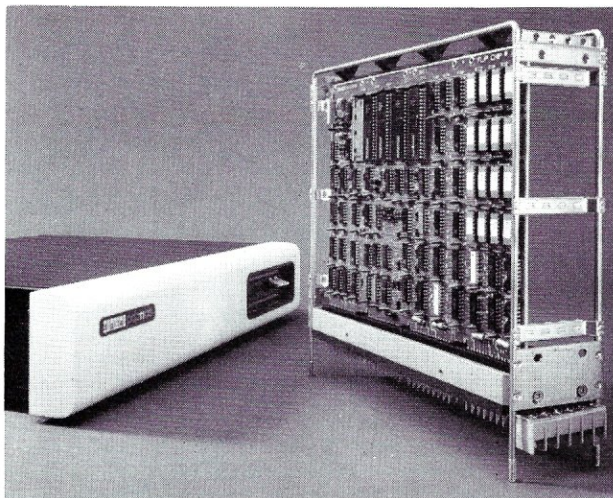


ADM-3K (24 × 80)	\$849.95
ADM-3 (12 × 80).....	\$949.95
	ASSEMBLED
ADM-3 (24 × 80).....	\$1099.95
	ASSEMBLED
LOWER CASE OPTION	\$95.00

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 Vector interrupt handling
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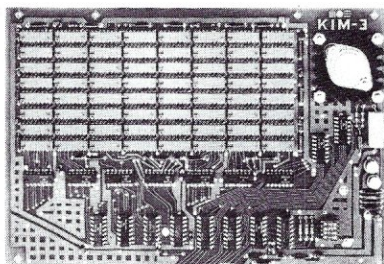
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ITEM	QUANTITY	DESCRIPTION	PRICE
TOTAL			

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pansion to 65K of memory can be implemented using KIM-4 motherboards.



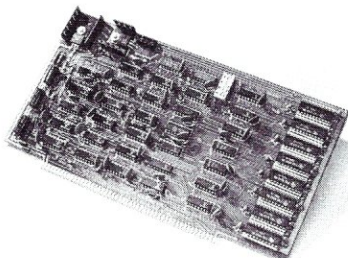
The price for the KIM-2 in quantities of 1-9 is \$179.00. For the KIM-3 it is \$298.00. Shipping and handling charges for either unit (U.S. and Canada) are \$3.00. For shipment elsewhere add \$15.00.

For further information contact MOS Technology; Valley Forge Corp. Center; 950 Rittenhouse Rd., Norristown, PA 19401; (215) 666-7950

CIRCLE INQUIRY NO. 252

Altair 88-S4K Memory Board

An ideal addition to the Altair 8800 series computer is the 88-S4K Synchronous 4K Memory Board, which has many outstanding features including totally synchronous design logic. This means the memory relies solely on the CPU for timing signals—no single shots and no critical on-board timing. There are no wait states so that the CPU runs at maximum speed.



The 88-S4K provides 4,096 bytes of Random Access Memory while consuming very low power. Each board contains memory protect circuitry and address selection circuitry for any one of 16 starting locations in increments of 4K. The entire 4,096 bytes of memory can be protected by switching to PROTECT. A DIP switch is used for board selection with no hardware jumpers, and test points have been installed at important signal outputs for ease of checkout and troubleshooting. Ferrite beads are used on all common supply lines for noise isolation.

For further information contact MITS, 2450 Alamo SE, Albuquerque, NM 87106; (505) 243-7821

CIRCLE INQUIRY NO. 253

MB-1 4K X 8 Memory Board

Originally designed for the MK-8 (8008) microcomputer. Can be adapted to the F8, 6800, 8080 and other systems. May be used in 1K, 2K, 3K, or 4K configurations. Uses 32 static RAMs 2102 or equivalent. Mates with an 86-pin. 156" spaced edge connector. 1 usec RAMs included.

For further information contact Mikos, 419 Portofino Dr., San Carlos, CA 94070.

CIRCLE INQUIRY NO. 254

MB-3 EROM Board

Altair 8800 and IMSAI 8080 plug compatible, usable in 2K x 8 or 4K x 8 DIP switch selection of addressing and wait cycles.

For further information contact Mikos, 419 Portofino Dr., San Carlos, CA 94070.

CIRCLE INQUIRY NO. 255

4K RAM/PROM Module

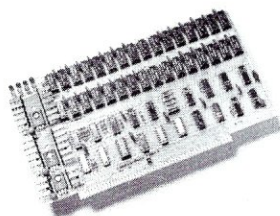
Designed to fill the memory requirements of small or dedicated systems, the 8025 RAM/PROM Module supplies up to 4096 (4K) 8-bit words of RAM and PROM memory. Up to 2K of Reprogrammable Read-Only Memory (PROM) is available in 256 word increments. Up to 2K of static RAM, Read/Write memory is also available in 1K increments.

For further information contact GNAT Computers, 8869 Balboa Ave., Suite C, San Diego, CA 92123.

CIRCLE INQUIRY NO. 256

4K RAM Board

A new 4K RAM board for use in the IMSAI 8080 computer and the Altair 8800 computer is being produced by IMSAI.



Not previously available for either one of these machines, the board allows 1K byte blocks of memory to be write protected or unprotected under program control or via the front panel switches.

For further information contact IMS Assoc., Inc., San Leandro, CA.

CIRCLE INQUIRY NO. 257

MB-2 4K X 8 Memory Board

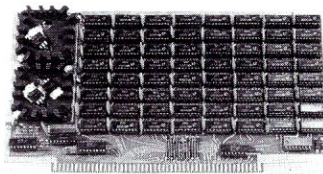
Altair 8800 plug compatible. 2102 static RAMs. Address and wait cycle selection by on-board DIP switches. Typical current requirements — 1 amp. Memory speeds may be switched to less than .55 usec, .55 to 1.05 usec, and 1.05 to 1.55 usec.

For further information contact Mikos, 419 Portofino Dr., San Carlos, CA 94070.

CIRCLE INQUIRY NO. 258

Low Power Memory 8KLST

The Dutronics 8KLST 8-bit word memory uses 500 nS MOS Static N-channel RAM chips.



With a 500 nS Read/Write cycle time no WAIT is required for access and with a static memory no refresh is needed. In case 8K is too much memory to start, try the 4KLST starter kit. It's the same board with only 4K 8 bit words implemented. Expand later to the full 8K words with expansion kit 4KXST.

For further information contact Dutronics, P.O. Box 9160, Stockton, CA 95208.

CIRCLE INQUIRY NO. 259

Octal Encoder Board Kit

This circuit is wired to the 8800's Display/Control board to allow entry of data or programs via a calculator type keyboard instead of the toggle switches. It does not require any additional I/O board or ROM's or software to operate. Due to the low cost of surplus calculator keyboards, cases and

LED displays available elsewhere, these items are not offered as part of this kit.

For further information contact Electronic Control Technology, P.O. Box 6, Union, NJ 07083.

CIRCLE INQUIRY NO. 260

TEST EQUIPMENT

"Slim Pack" Multirange DPM

International Microtronics Corporation has started production on its Model 324 "Slim Pack" Multirange Digital Panel Meter. The instrument, measuring 4.4" long x 1.85" wide x .6" thick, was specifically designed for NIM-BIN, Biomedical and Card Slide applications.

Typical specifications are: .4" bright orange L.E.D. display; auto-polarity; auto-zero; 200.0mV; 2, 20, 200 and 1000VDC fixed input range or manual 2-1000VDC range with auto decimal point display; overvoltage protection to 1200VDC; accuracy and linearity of 10.05%; 6 samples per second nominal; and temperature drift of \pm digit/5°C.

For further information contact International Microtronics Corporation, 4016 E. Tennessee Street, Tucson, AZ 85714; (602) 748-7900.

CIRCLE INQUIRY NO. 261

"Naked DPM"

International Microtronics Corporation has announced the introduction of its Model 325 called the "Naked DPM."



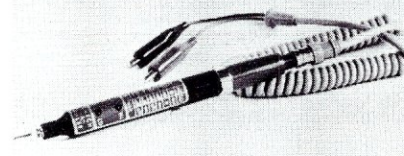
Actually the complete instrument is built on a single P.C. board measuring 2.9" long x 1.4" high x .35" thick. The L.E.D. display is bright orange .4" high with automatic polarity indication, external decimal point selection, 1000 megohms input impedance, \pm 1% accuracy and linearity, 7PA typical input bias current, temperature coefficient of \pm 0.005%/°C, power consumption of 550 mW, are typical specifications of the "Naked DPM." Four ranges are available — 1, 10, 100 and 1000VDC with up to 1200V overvoltage protection.

For further information contact International Microtronics Corporation, 4016 E. Tennessee Street, Tucson, AZ 85714; (602) 748-7900.

CIRCLE INQUIRY NO. 262

A Logical Solution To Digital Logic Problems

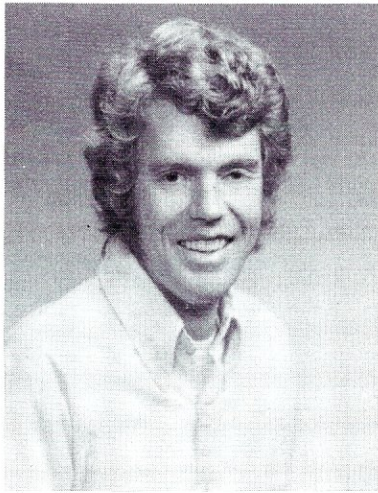
THE NEW CATCH-A-PULSE LOGIC PROBE is compatible with RTL, DTL, TTL, CMOS, MOS and Microprocessors using a 3.5V to 15V power supply.



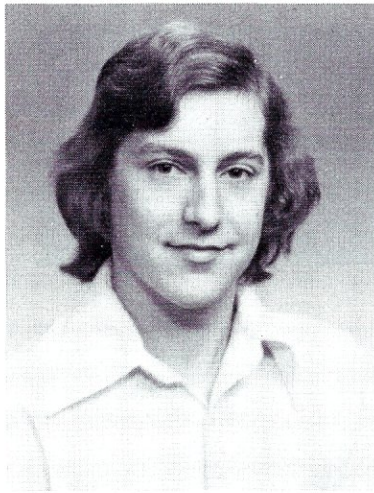
AVP Electronics
P.O. Box 45167, Unit One
San Diego, CA 92145

Thresholds automatically programmed for multi-

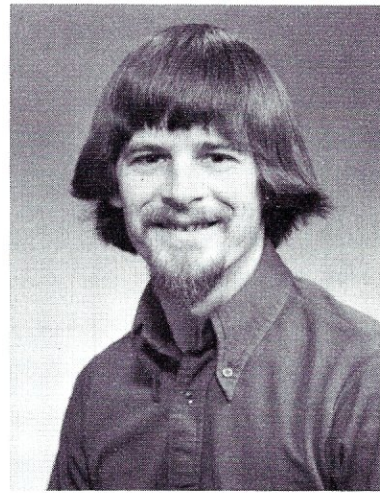
THE 1976 COMPUTER STORE ALL-STARS



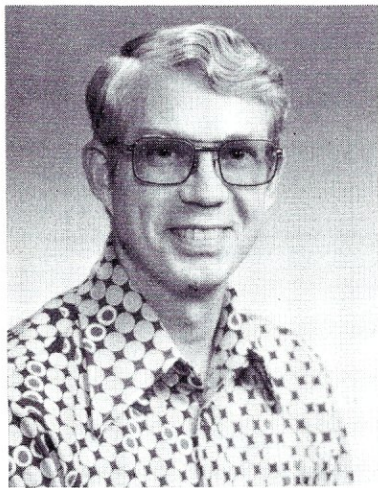
Mike Eusey



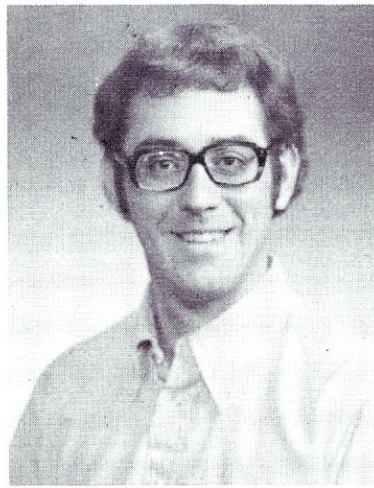
Steve Zook



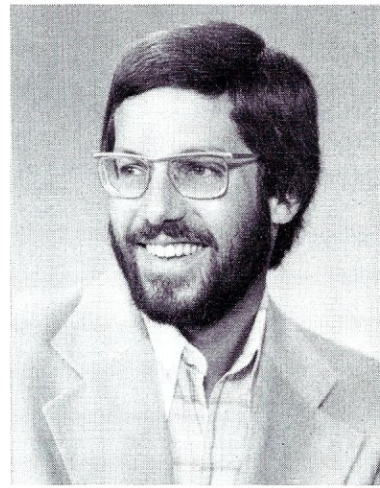
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logic family operation. Automatic resetting memory for single or multi-pulse detection. No adjustment required. Visual indication of logic levels, using LEDs to show HI, LO, bad level or open circuit logic or pulses (60 Nsec). Highly sophisticated, shirt-pocket portable, (protective cap over tip and removable coiled cord), eliminates the need for heavy test equipment. Introductory price \$24.95.

For further information contact AVR Electronics, P.O. Box 45167, San Diego, CA 92145; (714) 566 1570.

CIRCLE INQUIRY NO. 263

Elites and Adams

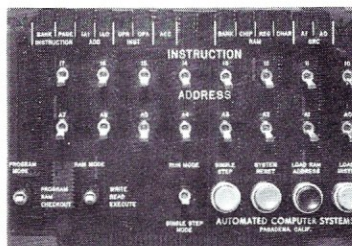
The Elites and Adams are instruments that complement any system where large interfaces need be designed quickly and directly without the need for wire wrapping, special adapters, or lengthy soldering.

For further information contact E and L Instruments, Inc., 61 First St., Derby, CT 06418; (203) 735-8774.

CIRCLE INQUIRY NO. 264

Microcomputer System Analyzer Model No. ACS-4040MCSA Has Two Faces

The ACS-4040MCSA is a low-cost multi-functional 4040 Microcomputer System Analyzer for varied microcomputer applications. The system analyzer can be used as a microcomputer control-display panel, as a hardware-software development tool, as a production check-out tool or as a field service maintenance tool.



Used as a program development tool, the system analyzer offers a cost-effective alternative to software operating system techniques for developing, trouble-shooting and debugging 4040 microcomputer programs in real-time by providing up to a 3 to 1 reduction in program development time without requiring memory hardware to store the software operating system nor requiring a TTY for program development interface. The purchase price of the analyzer is approximately 1/3 of the cost of a TTY and software operation system memory.

For further information contact R. A. Stevens, 2361 E. Foothill Blvd., Pasadena, CA 91107; (213) 449-0616.

CIRCLE INQUIRY NO. 269

Aut-ranging Frequency Counters

Four new aut-ranging frequency counters offering a high performance-to-price ratio have been added to the test instrument line of Hickok Electrical Instrument Company.



Designated the 380 Series Counters, they are available in four configurations offering a variety of capabilities. All units are aut-ranging with auto-decimal for "hands-off" operation.

For further information contact Hickok Electrical Instrument Company, 10514 DuPont Ave., Cleveland, OH 44108; (216) 541-8060.

CIRCLE INQUIRY NO. 271

Digital Logic Probe

A logic probe which tells you if the voltage is a logical one or a logical zero, using a seven-segment LED display.

For further information contact Sylvan Hills Lab, Inc., #1 Sylvanway, Box 239, Strafford, MO 65757.

CIRCLE INQUIRY NO. 273

Digital Pulse Generator

The DM-4 digital pulse generator is designed to fill the bill wherever a source of clean, crisp, fast output pulses compatible with virtually all logic families and discrete circuits is required.



It is capable of generating symmetrical and unsymmetrical pulses from 0.5Hz-5MHz and has a positive output of 100mV to 10V, with a rise and fall time of less than 30 nanoseconds. Additionally, DM-4 offers an independently controlled pulse width and spacing from 100 nanoseconds to 1 second in 7 overlapping ranges, as well as independent variable amplitude CMOS, and fixed amplitude TTL outputs.

For further information contact Continental Specialties Corp., 44 Kendall St., Box 1942, New Haven, CT 06509; (203) 624-3103.

CIRCLE INQUIRY NO. 274

MAKING THE RIGHT DECISION LET US HELP YOU COMPARE

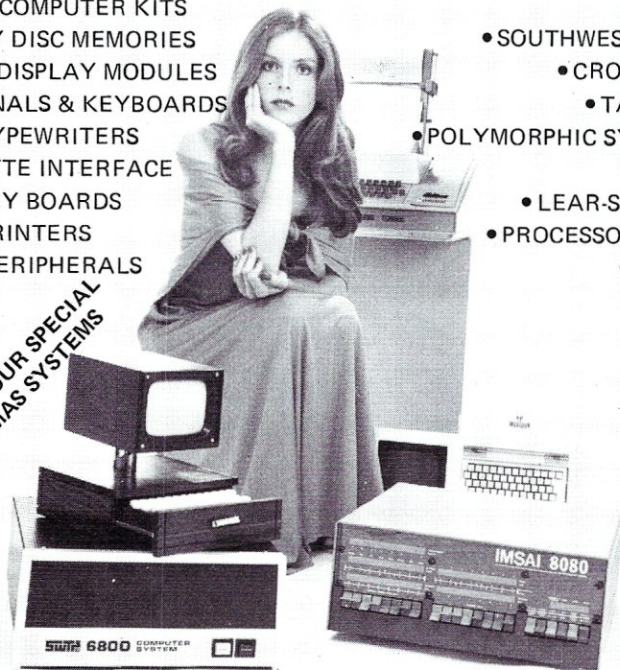
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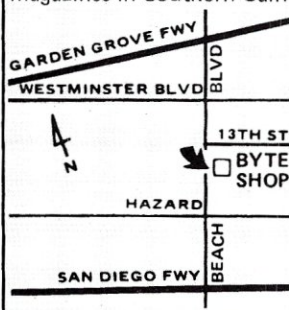
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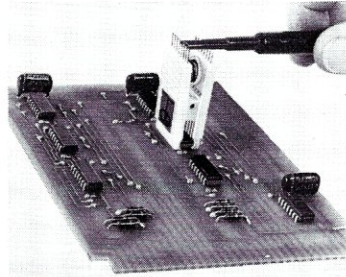
HOURS: MTWTF - 11:30-9; Sat 10-6
CLOSED SUNDAY



CIRCLE NO. 55 ON INQUIRY CARD

IC Test Clips

A P Products IC Test Clips grip DIP chips without slips to let you nip circuit problems in the bud. A P features eleven models of their IC Test Clips. The smallest clips to 8-pin mini-DIP packages and brings each pin out to a top row of terminals designed for attaching test probes or cable.



The largest A P IC Test Clip does the same for 40-pin LSI packages. Other models are designed for 14, 16, 16-pin LSI DIPs, 18, 20, 22, 24, 28 and 36-pin packages. Prices range from \$4.50 to \$21.00. A unique "contact comb" assures good connections while preventing shorts. These IC Test Clips are also excellent DIP pullers. Accessories are available, too. See the A P Products "Faster and Easier Book" or the A P Distributor near you. To find your nearest A P Products Distributor, call the toll-free Faster and Easier Line, 800-321-9668.

For further information contact Sharp Advertising, Inc., 24500 Chagrin Blvd., Cleveland, OH 44122; (215) 464-3636.

CIRCLE INQUIRY NO. 275

Flat Ribbon Jumpers

Available now from AP Products Inc., a directly interchangeable, fully assembled jumper line that is a cost effective alternate to the customer assembled mass terminated flat cables.

Three basic end terminations are available — these are socket connectors, printed circuit board connectors, and card-edge connectors. Each of these termination types is offered in the five most standard widely used sizes; 20, 26, 34, 40 and 50 contacts. With the types and sizes listed AP offers 60 standard single end configurations and 135 double end configurations. Additionally, AP can provide daisy chain assemblies tailored to customer requirements using any mix of end termination types.

For further information contact Robert J. Gabor, AP Products Inc., Box 110E, Plainville, OH 44077; (216) 354-2101.

CIRCLE INQUIRY NO. 276

Multi-Family Logic Probe

Continental Specialties Corp. has announced the availability of its Model LP-1 Multi-Family Logic Probe—a low-cost, pocket-sized, multi-function test instrument for digital applications.



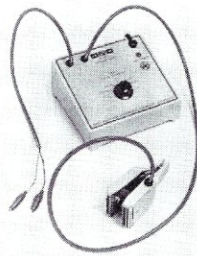
In a single housing not much bigger than a fountain pen, the LP-1 combines the functions of a pulse detector, pulse stretcher, and memory circuit, which provides an instant picture of static and dynamic circuit conditions with most popular logic families.

For further information contact Continental Specialties Corp., 44 Kendall St., Box 1942, New Haven, CT 06509; (203) 624-3103.

CIRCLE INQUIRY NO. 277

Second Generation Logic Monitor

Logic Monitor 2, a second generation digital test instrument incorporating a fully isolated power supply and selectable trigger threshold, which matches the precise characteristics of the logic family under test, has just been introduced by Continental Specialties Corp.



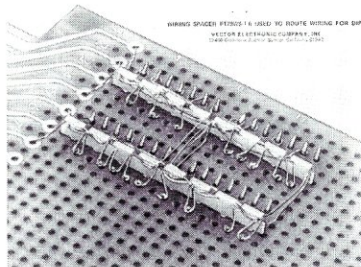
The LM-2 consists of two units, a connectors/display unit which clips over the IC, and a power supply module, which contains the precision reference power supply and logic family selector switch.

For further information contact Continental Specialties Corp., 44 Kendall St., P.O. Box 1942, New Haven, CT 06509; (203) 624-3103.

CIRCLE INQUIRY NO. 278

Spacers Aid Wire Routing

A new line of stamped-plastic wire spacers, from Vector Electronic Company, permits neat, orderly wire routing and prevents wires from inadvertently touching leads during soldering.



The spacers are formed to fit 0.041 in. diameter holes spaced on 0.02 in. centers. A series of oblong slots in the top accommodate 36- or 32-gauge plastic insulated hook-up wire or standard wrapping wire to 28-gauge.

For further information contact Vector Electronic Company, 12640 Gladstone Ave., Sylmar, CA 91342; (213) 365-9661.

CIRCLE INQUIRY NO. 279

IC Test Clips for Dual In-Line Packages

The AP Test Clip assures positive, non-shorting electrical connection and positive mechanical clamping to dual-in-line packages.

Gold-plated phosphor bronze spring contacts are designed for wiping action.

The "contact comb" separating the spring contacts provides positive positioning to prevent accidental shorting of adjacent leads.

For further information contact AP Products, P.O. Box 110Q, Dept. 1, Plainville, OH 44077.

CIRCLE INQUIRY NO. 280

3,648 Solderless Plug-In Tie Points

Model 236, the largest in the ACE series, offers the user virtually unlimited circuit-building flexibility. The universal matrix of 3,648 solderless, plug-in tie points is comprised of 512 separate 5-tie-point terminals, 32 vertical distribution buses (each with five connected 5-tie-point terminals) plus 4 horizontal buses (each with 18 connected 4-tie-point terminals). These buses may be linked in any combination to provide unique or common functions such as voltage and ground distribution, reset lines, clock lines, shift command, etc.

For further information contact AP Products, P.O. Box 110Q, Dept. 1, Plainville, OH 44077.

CIRCLE INQUIRY NO. 281

IT'S FOXY TO HAVE YOUR OWN COMPUTER!

For a sophisticated system, the Altair 8800A computer and ADM3 video terminal make the perfect couple. Whatever you need in the way of Altair® equipment, you can get it at Marsh Data systems.

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CIRCLE NO. 44 ON INQUIRY CARD

POWER SUPPLIES

Microprocessor-Based Systems' Line

The SMP Series has been developed to serve the particular and exacting requirements of microprocessor-based systems and related peripheral requirements. The models shown in the table below, have proven their reliability and performance in hundreds of installations, under actual equipment operating field conditions — for over one year!

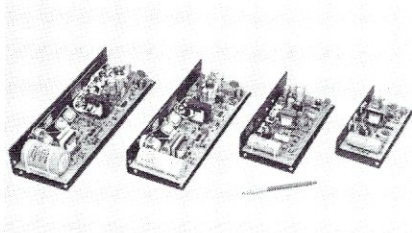
The 10 SMP Series triple and quadruple output models listed below fulfill the needs of most of the popular microprocessor-based systems on the market today.

For further information contact Standard Power, Inc., 1400 So. Village Way, Santa Ana, CA 92075; (714) 558-8512 TWX 910-595-1760.

CIRCLE INQUIRY NO. 282

Boschert Power!!

BOSCHERT switching power supplies offer a 90% weight reduction, a 75% space reduction and an 80% heat reduction over the conventional linear power supply. In addition, they are priced competitively with linear supplies! This combination of advantages offers an obvious technological match to micro-computer systems. Why attach a beautifully compact, light weight digital system to a boat anchor?



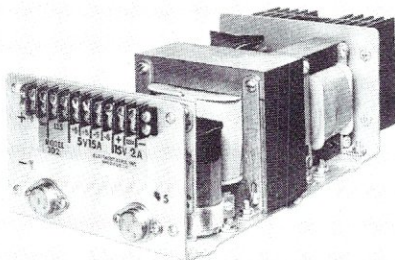
BOSCHERT currently offers two models oriented toward microcomputer applications, the Model OL60 and the Model OL80. Both supplies have 4 outputs and weigh less than 1.5 pounds. The Model OL80 is oriented towards large micro-computer systems and the OL60 towards smaller ones. Output voltages of +5 and +12 are available with either supply.

For further information contact Boschert Associates, 1031 East Duane, Suite C, Sunnyvale, CA 94086; (408) 732-2440.

CIRCLE INQUIRY NO. 283

Computer Power Supplies

A new catalogue featuring Computer Power Supplies is now available from ELECTROSTATICS, INC.



Singles, Duals and Triples having excellent ripple and regulation are carried in stock for immediate delivery.

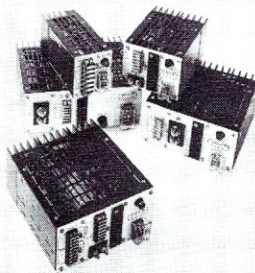
Prices start at \$26.00 with liberal quantity discounts obtainable.

For further information contact Electrostatics, Inc., 7718 Clairemont Mesa Blvd., San Diego, CA 92111; (714) 279-1414.

CIRCLE INQUIRY NO. 284

Switching Power Supplies

Gould MG Switching Power Supplies are compact, light weight, and highly efficient. Operating from 115V (220/240V optional), 45-440 Hz, the units provide 0.1% regulated, low-ripple dc output voltages of 5, 12, 15 or 24V at currents from 4 to 60 amps.



Features include full output ratings to 50°C, over-voltage and overcurrent protection, remote sensing, and remote programming. MGT unit in foreground is a triple output power supply with main output of 5V and two auxiliary outputs of 12V or 15V dc.

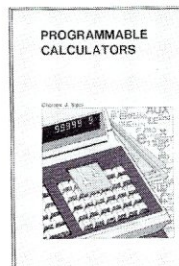
For further information contact L. R. Keenen, Gould Inc., Power Supply Department, 3631 Perkins Ave., Cleveland, OH 44114; (216) 361-3315.

CIRCLE INQUIRY NO. 285

LITERATURE

Programmable Calculators By: Charles J. Sippl

An introductory textbook on calculators that reviews calculator capabilities, usage and programming from the basics of how to use keyboards, special function keys and preprogrammed units to advanced programmable calculator systems for use in engineering, science and communication.



Includes a section on programming processes and procedures for calculators and a glossary of calculator terms.

For further information contact Matrix Publishers, Inc., 207 Kenyon Rd., Champaign, IL 61820.

CIRCLE INQUIRY NO. 286

1024 Questions And Answers About Home Computers By Richard L. Didday

A book for the person interested in microcomputers who wants to get an idea of what it can be like before buying the equipment and for the person with a microcomputer who wants ideas for things to do, help in reading the literature, help in deciding what ways to go.

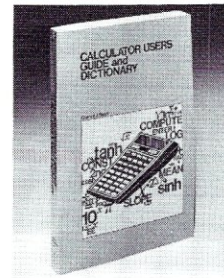
Price: \$4.95 Approximately 150 pages.

For further information contact Matrix Publishers, Inc., 207 Kenyon Rd., Champaign, IL 61820.

CIRCLE INQUIRY NO. 287

Calculator Users Guide and Dictionary By Charles J. Sippl

A handy reference and buyer's guide which also shows you how to use today's "keyboard computers."



The first section will tell you how to best utilize your new calculator. The next section will help you decide which calculator is best for you. All this is followed by a 7000 term dictionary on terms relating to calculators.

Price: \$9.95 Pages: 425 pages

For further information contact Matrix Publishers, Inc., 207 Kenyon Rd., Champaign, IL 61820.

CIRCLE INQUIRY NO. 288

Micro-68 User's Manual

San Diego — Electronic Product Associates, Inc., 1157 Vega Street, San Diego, CA 92110, (714) 276-8911, has announced the availability of a new 66 page User's Manual for the Micro-68 Micro-Computer prototyping system. The new manual contains complete information on the Micro-68 including programming examples and a flow charted listing of the new MON-1 monitor program. The price is \$5.00, refundable with the purchase of a Micro-68 system.

For further information contact Patti Neumann, Director of Marketing, Electronic Product Associates, 1157 Vega Street, San Diego, CA 92110; (714) 276-8911.

CIRCLE INQUIRY NO. 289

Circuit-Stik/Centron Announce New Literature Available

Circuit-Stik, Inc. and its sister company, Centron Engineering, Inc., are proud to announce the release of their new condensed catalog #503. This new catalog merges for the first time, three distinct product areas manufactured by Circuit-Stik and Centron Engineering. These areas are as follows: 1) Circuit-Stik's unique sub-elements for making instant circuit boards, 2) Pre-etched GP (General Purpose) prototype and wire wrap socket boards, and 3) Centron Engineering's printed circuit drafting aids for making circuit board master artworks.

For further information contact Circuit-Stik, Inc./Centron Engineering, Inc., 24015 Garnier Street, Torrance, CA 90505; (213) 530-5530 Telex: 69-8223.

CIRCLE INQUIRY NO. 290

On-Line-Lives!

ON-LINE is a classified-format advertising newsletter through which Computer Hobbyists can buy, swap and sell equipment, programs and services related to the field of home, small business and personal-use computers. Published every three weeks and sent to subscribers via First Class mail, ON-LINE carries advertising submitted by individuals and commercial enterprises as well as New Product Announcements and computer club meeting schedules. Advertising rates, based on a 96-character line, vary from \$3.50/line for commercial ads to \$1.50/line non-commercial to free for several categories of ads of non-profit nature. New Product Announcements are carried free. Subscriptions are \$3.75 for 18 issues (1 year). A free sample issue is sent on request or is added to subscriptions.

For further information contact D. H. Beetle, Publisher, 24695 Santa Cruz Hwy., Los Gatos, CA 95030.

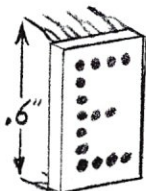
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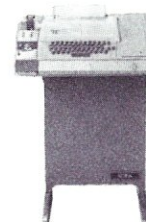
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Continental Specialties Catalog

"59 Ways to Save Time and Money Designing and Testing in Electronics," a full-color 32 page catalog of electronic prototype breadboarding and test equipment, is available from Continental Specialties Corp. For further information contact Continental Specialties Corp., 44 Kendall St., P.O. Box 1942, New Haven, CT 06509.
CIRCLE INQUIRY NO. 292

Microprocessor Coding Forms

Pad of 50 sheets of a coding form for those who write programs in machine language.
For further information contact Electronic Control Technology, P.O. Box 6, Union NJ 07083.
CIRCLE INQUIRY NO. 293

MFE Operation and Interface Manual

MFE Operation and Interface Manual for the MFE Model 250B Digital Cassette Tape Transport containing information on general performance and specifications of digital cassette tape transports including mechanical, electrical, engineering definitions, general performance characteristics, technical specifications, and cassette specifications.
For further information contact MFE, Keewaydin Dr., Salem, NH 03079; (603) 893-1921.
CIRCLE INQUIRY NO. 294

Cassette Catalog

Memodyne Corporation of Newton Upper Falls, Massachusetts announces a new catalog of O.E.M. incremental and continuous digital recorders, transports, data loggers, RS232C input/output recorders, Texas Instruments and Wang Laboratories Compatible Recorders. In addition a listing of applications with recorder recommendations is given as well as an introduction to digital cassette recording.

For a copy of this product guide write to Memodyne Corp., 385 Elliot St., Newton Upper Falls, MA 02614.

For further information on this release contact Mr. Kevin Corbett, Marketing Manager, Memodyne Corporation; (617) 527-6600, Telex: 92 2537.
CIRCLE INQUIRY NO. 295

E & L Instruments Offers Its 1976-1977 Catalog of Electronic Circuit Design Aids

A 26-page catalog of electronic circuit design aids from sockets and bread-boards to complete educational systems is now available from E & L Instruments, Inc., Derby, Conn. The new Circuit Design Line catalog includes more than 180 different products for everyone who builds electronic circuitry.



Products from E & L Instruments assist the professional designer in circuit development, help the student to understand electronics, bring the latest in technology to the hobbyist and aid the scientist in applying electronics to experimental apparatus.

Copies of the Circuit Design Line catalog are available from E & L Instruments, Inc., and its representatives.

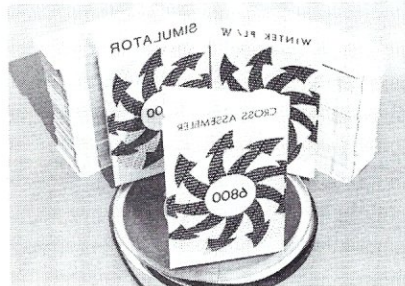
For further information contact Richard Vuilleque, E & L Instruments Inc., 61 First St., Derby, CT 06418; (203) 735-8774.

CIRCLE INQUIRY NO. 296

SOFTWARE

6800 Software

All WINTEK software is written in standard FORTRAN IV for any computer with a word size of 16 bits or more.



Overlay version for small machines. Cross Assembler, \$600, produces absolute or relocatable code; PL/W Cross Compiler, \$1000, is styled after PL/1 * is compatible with PL/M, * and produces relocatable code; Linking Loader links assembler, PL/W, and library routines into absolute code; Simulator, \$600, simulates MPU, RAM, ROM, ACIA, and PLA.

For further information contact WINTEK Corporation, 902 N. 9th Street, Lafayette, IN 47905; (317) 742-6802.

CIRCLE INQUIRY NO. 297

SCALBAL is here. Now. Only \$49.

Introducing the new microcomputer language that's simpler than machine language ... SCALBAL. Scientific Elementary BASIC Language for 8008/8080 systems.



Look at all you get! 5 Commands: SCR, LIST, RUN, SAVE, LOAD. 14 Statements: REM, LET, IF ... THEN, GOTO, FOR with STEP, END, INPUT, PRINT, NEXT, GOSUB, RETURN and optional DIM. 7 Functions: INT, SGN, ABS, SQR, RND, CHR, TAB. And, it runs in 8K and more.

For further information contact SCALBI Computer Consulting Inc., 1322 Boston Post Road Rear, Milford, CT 06460; (203) 874-1573.

CIRCLE INQUIRY NO. 298

VTL/2

The worlds most powerful "tiny" language. Designed to fit the three empty PROM sockets in your Altair 680, "Very Tiny Language 2" provides the user with an "instant on" high level language similar to BASIC. Features include string functions, subscripted arrays (both numeric and string), computed GOTO and GOSUB statements, unlimited depth of parenthesis in expressions (both logical and arithmetic), and built in random number generator. All that in 768 bytes of PROM!

Package includes user's manual, commented source listing, "games you can play in only 1K", a

collection which includes such favorites as NIM, HURKLE, LIFE, CRAPS, and MINITREK! Also included is a functions package with full trig, log, and exponential functions.

The price, including PROMS is \$114.00 (VTL/1 owners may trade in old PROMS for \$15.00).

For further information contact The Computer Store, 820 Broadway, Santa Monica, CA 90401.

CIRCLE INQUIRY NO. 299

Microcomputer Subroutine Package

Pragmatic Systems has announced a package of commonly used microcomputer subroutines written in 8080 assembly language. The package, called UT1, contains commonly used code conversions, I/O routines for numbers and character strings, and I/O drivers for commonly used peripherals.

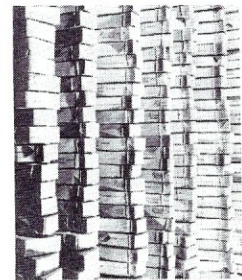
Source listings of the program with user documentation are available for \$3.00 each plus \$.35 for shipping and handling. (California residents add \$.20 sales tax).

For further information contact Pragmatic Systems, P.O. Box 43, Mountain View, CA 94042.

CIRCLE INQUIRY NO. 300

Intel Microcomputer User's Program Library Service

Hundreds of microcomputer programs will be made available on paper tape and in listing form through a new, expanded user's library announced today by the Microcomputer Systems Division of Intel Corporation.



Named Insite TM (Intel Software Index and Technology Exchange), the new library will be operated as an industry service by the division. It is an outgrowth of the Intel Microcomputer User's Library, the largest known collection of general-purpose microcomputer programs.

For further information contact ITEL Corporation, 3065 Bowers Ave., Santa Clara, CA 95051.

CIRCLE INQUIRY NO. 301

Opus/One, High-Level Language Compiler Introduced by ASI

ASI has announced OPU\$ONE, a high-level language compiler that incorporates the strong points of several large-system languages such as ALGOL and FORTRAN, yet maintains the commands, statements and simplicity of BASIC.



According to the manufacturer, it is faster and more efficient in memory utilization, yet simpler to learn than BASIC. ASI states that the non-professional will find programming easy and straightforward; the professional will discover that many unique and creative combinations of code are possible, enhancing the program efficiency and power.

Some highlights of the language are: arithmetic precision up to 126 digits; strings automatically

converted to numbers during numerical operations, with any length up to 128 characters; GOTO, GOSUB parameters can be variables or strings; variables, virtually unrestricted in character length, can represent a number, string or matrix; matrices up to 255 dimensions with either number or string elements; I/O print format statement has right and left justification, carriage return/line feed control within the parameter list; block structure similar to ALGOL's BEGIN-END features (brackets delimit blocks of program code). I/O handlers are available for most RS-232 and current loop devices. OPUS/ONE comes in floppy disk and audio cassette tape configurations, and requires a minimum of 8K bytes of memory. Custom configurations are also available.

The Disk version is available at \$300; Cassette at \$250. A detailed user's guide is available for \$5.

For further information contact Mal R. Lockwood, Administrative Systems, Inc., 222 Milwaukee, Suite 102, Denver, CO 80206; (303) 321-2473.

CIRCLE INQUIRY NO. 302

New BASIC Interpreter

Called BASIC ETC, the new interpreter was co-developed by John Arnold and Dick Whipple to Tyler, Texas, authors of the original Tiny BASIC programming language.

An interpreter, in contrast to a compiler, translates and executes the user's program directly. A compiler generates a machine code program which is subsequently executed independently of the high level source program.

They decided on an interpretive translator for convenient editing and quick program development capability.



BASIC ETC uses the lower 8 KB of memory plus at least 1 KB of RAM for scratchpad. Since BASIC ETC is for games and business applications, the less frequently used scientific functions of Dartmouth BASIC are not available.

Kits may be ordered from the Micro Store, 634 S. Central Expressway, Richardson, Texas, 75080. The Micro Store is the retail affiliate of Richardson-based Binary Systems, Inc.

For further information contact Binary Systems, Inc., 634 S. Central Expressway, Richardson, TX 75080.

CIRCLE INQUIRY NO. 303

Star Trek/Space War Program Offered

A version of the STAR TREK/SPACE WAR computer game is now available for the ALTAIR 8800. It is written in ALTAIR 4K BASIC and is available from International Data Systems, Inc.

For further information contact International Data Systems, Inc., P.O. Box 593001-AMF, Miami, FL 33159.

CIRCLE INQUIRY NO. 304

Varian Software Described

Varian Data Machines has a six-page brochure describing its software systems capability.

Varian Software Systems, describes Vortex, Varian's powerful real time operating system. Subsystems which operate under Vortex are also presented.

For further information contact Varian Data Machines, 2722 Michelson Drive, Irvine, CA 92713.

CIRCLE INQUIRY NO. 305

4K and 8K BASIC [c]

Southwest Technical Products Corporation has just released its 4K and 8K Basic (c) software. Both feature fixed and floating point math with a full 1.0E-99 to 9.999999999E + 99 number range. In addition to the line number mode a direct (no line number) mode of execution is provided on most statements to create a calculator like mode of entry for short programs. Provisions have been made in both packages for saving and loading BASIC programs to and from either cassette or paper tape. A USER function is even provided for jumping to machine language subroutines.

Both packages have been written for the SWTPC 6800 Computer System. The 4K Basic (c) requires a minimum of 6K of memory with 8K recommended, while the 8K Basic (c) requires a minimum of 8K of memory with 12K recommended. The 4K Basic (c) tape and manual sell for \$4.95 on "Kansas City" cassette tape and \$10.00 on paper tape. The 8K Basic (c) tape and manual sell for \$9.95 on "Kansas City" cassette tape and \$20.00 for paper tape. All prices are postpaid in the U.S.

For further information contact Southwest Technical Products Corporation, 219 W. Rhapsody, San Antonio, TX 78216.

CIRCLE INQUIRY NO. 306

Home-Study Course in Microcomputer Programming From Logical

Modu-Learn™ is a complete home study course in microcomputer software design for the new programmer. The course is divided into 10 self teaching lessons, plus additional background information on microcomputer architecture, selection criteria, and hardware/software tradeoffs. Each lesson presents fundamental structured software design techniques followed by an explanation of how to implement these techniques on any microcomputer.

Modu-Learn™ is available now for \$49.95 plus \$2.00 for postage and handling.

For further information contact Logical Services Incorporated, 711 Stierlin Road, Mountain View, CA 94043.

CIRCLE INQUIRY NO. 307

Exclusive Directory of Remote-Access Packaged Software

Gregory Research has compiled a complete directory of all the thousands of pre-packaged computer programs and data-bases in every field available from hundreds of low-cost timesharing sources to anyone with "hunt & peck" typing ability, an inexpensively rented typewriter style data terminal and a telephone. No computer programming ability is required as all the programs and data-bases use an English language, question and answer technique.

Broad areas such as accounting, design, economics, education, engineering, finance, insurance, management, manufacturing, marketing, math, personnel, physics, planning, real estate, scheduling, statistics, stocks & bonds, structural analysis, taxes, transportation and so forth are indexed.

RCPD is available on a mail-order basis with the first three bi-monthly updates included in the postage pre-paid cost of \$28.00.

For further information contact Gregory Research Associates, 1900 Greymont Street, Philadelphia, PA 19116.

CIRCLE INQUIRY NO. 308

Microprocessor Software/Hardware Development System Provides Floppy-Disc Performance at Half the Cost

Processor Applications Ltd., introduced a new concept in microprocessor design tools. Tagged the µPAL2650, the system boasts performance

P.O. Box 4430N Santa Clara, CA 95054
(408) 988-1640



Same day shipment. First line parts only. Factory tested. Guaranteed money back. Quality IC's and other components at factory prices.

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SN7458N	70			NE565A	1.00	CD4058	25		
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SN7469N	45			NE566V	1.85	CD4071	40		
SN7470N	45			NE567V	1.25	CD4072	40		
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SN7568N	45			LM3037N	35	SN74947CN	39		
SN7569N	45			LM3037N	35	SN74948CN	39		

comparable to floppy-disc based systems at about one-half the cost. The system presently supports the 2650 microprocessor, however, future offerings will include software to support other popular microprocessors available today.

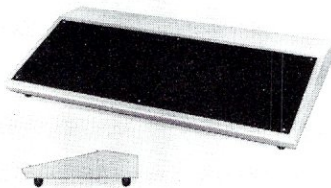
The μ PAL 2650 is expandable to meet the user's needs and is available from stock, FOB West Covina, California. For further information contact Processor Applications Ltd., 2801 East Valley View Avenue, West Covina, CA 91792; (213) 965-8865.

CIRCLE INQUIRY NO. 309

MISCELLANEOUS

Keyboard and Instrumentation Enclosure

The Univue keyboard and instrumentation enclosure is designed for general purpose, low profile instrumentation and computer data entry applications.



Special design features included a welded steel body of two piece construction for strength with an outside removable, flush mounting front panel.

For further information contact Advanced Data Sciences, P.O. Drawer 1147, Marion, OH 43302; (614) 382-7917.

CIRCLE INQUIRY NO. 310

Encoded Keyboard

Keyboard features diode matrix encoding, no expensive ROMs to burn out. It has 60 keys, both upper and lower case, with 8-bit parallel output. Both data and strobe are negative logic. There is 2 key roll over, an output latch on each bit line, and power requirements are single 5-volt supply at 250 to 250mA.

For further information contact Sargent's Dist. Co., 10268 Rosecrans, Bellflower, CA 90706; (213) 925-6315.

CIRCLE INQUIRY NO. 311

Altair and IMSAI Users

A Scott Instrument Co. "Buffer In" buffer module eliminates virtually all control panel CPU loading and resultant waveform degradation. Use of a "Buffer In" improves data bus signal quality and also reduces power dissipation in the 8080 CPU.

For further information contact Scott Instrument Company, 3734 W. Slauson Ave., Los Angeles, CA 90043; (213) 296-4913.

CIRCLE INQUIRY NO. 312

New Recording Head For Tape Cassette Units

A new data recording head for tape cassette units, constructed entirely of ceramic and ferrite material, extends head life up to three times over conventional units that use laminated alloys. The Model FCH-1 from Information Magnetics Corporation, is for read-after-write applications in Philips-type data cassettes.

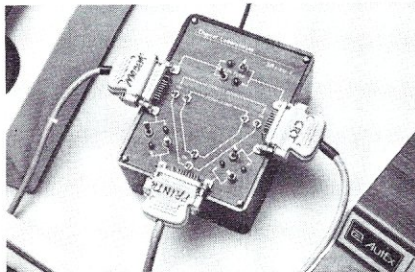
The new unit is a single-track dual-gap head for data recording cassette units, of the kind usually used in intelligent typewriter, and other "desk-top" computer and word-processing applications.

For further information contact Information Magnetics Corporation, 5743 Thornwood Drive, Goleta, CA 92017; (805) 964-6828.

CIRCLE INQUIRY NO. 313

Universal Junction Unit Allows Serial Devices Of Different Manufacturers To Be Connected

Solving circuit connection headaches often encountered when connecting different manufacturer's RS-232C devices, a new compact connection unit, the "3R", permits combining three devices such as Teletypes, modems, printing terminals, video displays, and computers in a common system. Furthermore, the 3R units themselves can be connected together, expanding indefinitely the number of devices that can be combined.



A typical application is adding a cassette unit to operate in parallel with a Video Display/Keyboard already connected to a modem or a computing system.

In the "headache solving" category, each of the three ports on the 3R have associated switches that interchange the transmit and receive signals, and set up operation in either the voltage (RS-232C) or current loop (20 ma) mode.

For further information contact William M. Kahn, Digital Laboratories, 600 Pleasant Street, Watertown, MA 02172; (617) 924-1680.

CIRCLE INQUIRY NO. 314

Sunshine Computer Company

Sunshine Computer Company is a new computer store in the Los Angeles area. We feature APPLE, JOLT, OSI-CHALLENGER, and MICRO-68 computers. Both kits and assembled units are available and all are sold at "computable prices." We have demo units for each computer up and running on the premises and invite you to come in and try them out. Complete package plans are our specialty and are guaranteed to save the computer hobbyist many dollars off the usual computer store prices. We are equipped for processing mail orders of customers outside of our area. SUNSHINE COMPUTER CO. is growing fast and will probably have moved to our new store by the time this is printed so call us first to be sure.

For further information contact Sunshine Computer Company, 9 Palomino Lane (offices), Carson, CA 90745. Or call and ask for Rich Travis at (213) 830-8965.

CIRCLE INQUIRY NO. 315

Altair Clock Fix Kit

The Parasitic Engineering Clock Fix Kit includes a special bipolar MSI integrated circuit, temperature compensated to assure tight clock pulse specifications. Only \$15. Your Altair can't work reliably without a reliable clock. Special Christmas offer. Both kits for only \$85. Orders must be postmarked no later than Dec. 25, 1976 to receive this special price.

For further information contact Parasitic Engineering, P.O. Box 6314, Albany, CA 94706

CIRCLE INQUIRY NO. 316

Handy Dandy Paper Tape Winder

The Handy Dandy is a hand held paper tape winder provided by SCCS member Bill Roch. Powered by four D batteries, this tape winder facilitates repeated winding of punched paper tapes into a neat roll.

For further information contact Elliam Associates, 24365 Clipstone St., Woodland Hills, CA 91364, (213) 348-4278

CIRCLE INQUIRY NO. 317

Low Cost Series Of Highspeed Current Output D/A Converters

Computer Labs has announced a new low cost series of highspeed current output D/A converters. Available in eight, ten, or twelve bit resolution, the Models MDSL-0802, 1002, or 1201 are ideally suited for applications such as computer graphics generation, wave form generation, and television picture reconstruction — as well as many others.



As the result of binary digital input changes, the analog output of these D/A's will settle to within 0.1% of FS in 100 ns. The full scale output, which is 5 mA, can be either unipolar or bipolar depending on pin interconnections. For unipolar outputs, only a +15V power supply is required. The MDSL-0802, 1002, or 1201 D/A's are priced to be well within the range of hobbyists at \$39, \$49, and \$59 respectively. Delivery is stock to four weeks. Prices are F.O.B. factory.

For further information contact Ed Graves, Computer Labs, Inc., 505 Edwardia Drive, Greensboro, NC 27409; (919) 292-6427.

CIRCLE INQUIRY NO. 318

Improved Power Supply for Altair 8800

Parasitic Engineering is now offering a constant voltage power supply kit for the Altair 8800 and 8800A. It's designed to make the Altair almost immune to unreliable performance due to power line fluctuations. The power supply delivers full output (8 volts at 12 amps, plus and minus 16 volts at 2 amps total) even when the line voltage is as low as 90 volts. It also provides increased isolation from line noise and excellent over-voltage protection. The output rises less than 2% with an increase in line voltage to 130 volts.



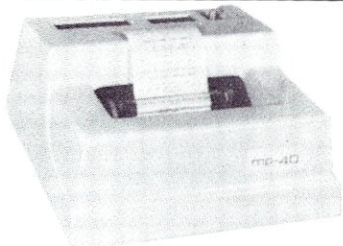
The power supply kit is available for \$75 postpaid (California residents add \$4.50 sales tax) and comes complete with all necessary components and step-by-step instructions for easy installation. Order now! Price increases January 1, 1977.

For further information contact Parasitic Engineering, P.O. Box 6314, Albany, CA 94706.

CIRCLE INQUIRY NO. 319

Data Center

The Data Center, a computer store, is located at 136 N. Maryland Avenue, Glendale, CA 91206, (213) 243-0087. As an authorized SPHERE microprocessor representative, The Data Center offers both hardware and software support to computerists in the San Fernando Valley, the San Gabriel Valley, and Los Angeles area. Additionally, the store carries numerous high performance computer peripherals such as: Magnetic Tape units, Magnetic Disc Units (floppy discs, cartridge, disc pack), printers, card readers, paper tape



The completely assembled and tested MP-40 printers continue to be the favorite of commercial users and hobbyists alike. Featuring a 5X7 impact dot matrix, 40 columns, 75 lines per minute, 4" adding machine paper, molded casework, zinc-plated chassis and power supply. Choose from one of these three interface models.

- **LCP** • 8-bit Parallel I/F without character generator for special software fonts **\$329**
- **ASCII** • 8-bit Parallel Interface with a 64 character ASCII set **\$425**
- **SSP** • Intelligent RS232 or Current Loop data terminal. Async Serial I/F **\$499***

*Introductory price for prepaid orders are good until Dec. 31, 1976

OR SELECT THE "NO FRILLS" KP-40 KIT

- Mechanism, LCP I/F PC board & components
- Power transformer and assembly instructions **\$179**

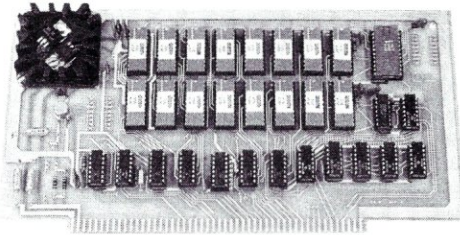
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- ★ **FAST 215 nS—FULL SPEED—FOR Z80 ALSO**
- ★ **EXCEPTIONALLY LOW POWER—LESS HEAT**
- ★ **LESS THAN OTHER "LOW POWER" MEMORY**
- ★ **BATTERY STAND-BY CAPABILITY**
- ★ **ALL SIGNALS TO MOS DEVICES BUFFERED**
- ★ **LOW-PROFILE SOCKETS FOR ALL IC's**

PROTOTYPING BOARD
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EDGE CONNECTORS
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ELECTRONIC CONTROL TECHNOLOGY
P.O. BOX 6 UNION, NEW JERSEY 07083

CIRCLE NO. 48 ON INQUIRY CARD

Reader/punchers, terminals, modems, etc. All peripherals are used and priced at prices that the hobbyist can afford. A complete line of packaged semi-conductors, electronic components, capacitors, resistors, diodes, etc. is available for the shopping convenience of the hobbyist.

CIRCLE INQUIRY NO. 320

Direct-Etch and Positive Photo-Resist Kits Simplify Etched Circuit Board Fabrication

Two new etched circuit board kits, from Vector Electronic Company, facilitate rapid production of quality circuit boards without expensive and time-consuming processing with cameras and dark-rooms. The kits, Model No. 32X-1 and 32XA-1, contain positive resist coated circuit boards, bare copper clad boards, and all materials necessary for fabricating circuit boards by the direct-art-then-etch process, and also by the positive photo-resist pro-



Vector etched circuit kits are useful for both engineering and experimental circuit board fabrication. Existing full-scale artwork may be copied directly from hobby magazines with the supplied tracing and artwork materials.

For further information contact Vector Electronic Company, Inc., 12460 Gladstone Ave., Sylmar, CA 91342; (213) 365-9661.

CIRCLE INQUIRY NO. 321

Pocket Data Terminal

Internal, rear-mounted acoustic transducer provides instant, fumble-free, no-wires-required data input to any telephone mouthpiece, or two-way radio or tape recorder microphone... simply hold the Pocket Data Terminal up to the microphone and press the Auto-Dial button and within seconds the computer has answered and you can start entering data via the keyboard.



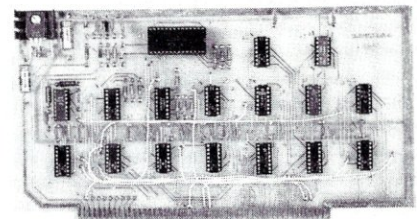
The Pocket Data Terminal Model PDT-1000 offers a significant security advantage to prevent unauthorized persons entering or gaining access to any system since all 7 (or less) Touch-Tone* digits can be outputted from memory as fast as 1/2 of a second total elapsed time.

For further information contact Executive Devices, 740 S. Locan, Fresno, CA 93727.

CIRCLE INQUIRY NO. 322

Comptek Announces New CL2400 Real Time Clock

COMPTeK has recently introduced a unique real-time clock kit that is ALTAIR and IMSAI compatible. Designed specifically for ease of use, the new CL2400 real-time clock, is a self-contained, hardware-implemented clock. In its normal mode of operation it keeps time in 24-hour format from 00:00:00 to 23:59:59 with one second resolution.



The microcomputer system treats the device as a peripheral, allowing the six digits of the present time to be read by any high level language, such as BASIC, that has peripheral I/O capabilities (i.e., an OUT statement and an IN statement).

For further information contact COMPTeK, P.O. Box 516, La Canada, CA 91011.

CIRCLE INQUIRY NO. 323

Circuit-Stik, Inc.

Circuit-Stik, Inc. has announced the addition of a new "Etchable" circuit card to their growing line of GP (General Purpose) boards.



This new card is designed for "in-house" etching of desired circuit with the reliability of mil-spec gold over nickel plated contact fingers. By simply masking off the pre-etched and plated contact fingers and following standard in-house etching and drilling procedures a reliable gold plated finger card is achieved. Standard card cage size (4.5 X 6.5) and connector finger size and spacing (22 one side, 44 two sides on .156 centers) provide unlimited prototyping applications. The types available are: 1) GP Board Part No. 8117 (single sided) \$12.95 ea, and 2) GP Board Part No. 8117 (double sided) \$13.95 ea.

For further information contact Circuit-Stik, Inc., 24015 Garnier Street, Torrance, CA 90505; (213) 530-5530. Ask for Don Harper.

CIRCLE INQUIRY NO. 324

Universal 8 Port Unidirectional-Bidirectional Input/Output

The ACS-4040UBI/O-N PCB provides up to eight compatible T²L universal 4-bit T²L latch buffered microcomputer input and/or output ports/PCB for interfacing to ACS-4040MPU modules and ACS-4040MC microcomputers.

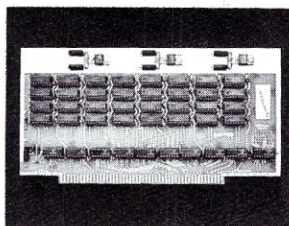
The eight ports can be configured in any combination of unidirectional input and output ports as a factory or field option.

For further information contact ACS, 2361 E. Foothill Blvd., Pasadena, CA 91107; (213) 449-0616.

CIRCLE INQUIRY NO. 326

Econoram

We took everything we learned from selling 4K x 8 RAM boards for the past year, added some of this year's circuit tricks, and came up with ECONORAM — a memory board that is even more remarkable due to its low price. We've engineered this with the user in mind, giving you several benefits:



Three regulators to share power load, plus optimized thermal design, means a cooler running microcomputer. Typical current consumption of under 750 ma gives your power supply a break.

LATE ENTRIES

4Kx8 Basic Ram \$88

This 4K by 8 memory board has no frills, just storage. Designed for compatibility with JOLT systems, this board is also ideal for other microcomputers using bi-directional buss systems. Same size as JOLT memory card, plus lo-power operation (750 ma) to keep you on good terms with your power supply.

For further information contact Godbout Electronics, Box 2355, Oakland Airport, CA 94614

CIRCLE INQUIRY NO. 325

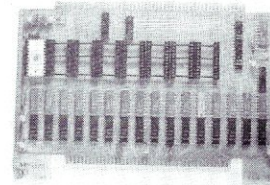
Fast — Zero wait states. All TTL support ICs are latest Low Power Schottky types. For reliable and unambiguous data transfer, all addresses, data lines, and outputs are buffered for minimum loading and maximum output capability. Power-on clear included.

For further information contact Godbout Electronics, Box 2355, Oakland Airport, CA 94614

CIRCLE INQUIRY NO. 327

2K Prom/Data RAM/Output PCB

The ACS-4040 2KPDRO PCB is a combinational PROM/DATA RAM/Output Port PCB. The PDRO PCB module provides on board expansion to 2K bytes of PROM program storage, 1280 words of Data RAM working storage and up to 16 RAM output ports. On board programmable jumper strap addressing provides user selected PROM-Data RAM PCB address assignments.



The PDRO module provides 1702A PROM socket capacity for up to 2K bytes of PROM program instruction storage in 256 byte increments/1702A PROM IC. A maximum of 8K bytes of combined PROM and R/W RAM program storage may be mechanized by the ACS-4040 series microprocessors.

For further information contact ACS, 2361 E. Foothill Blvd., Pasadena, CA 91107; (213) 449-0616.

CIRCLE INQUIRY NO. 328

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The 16K static RAM memory by **MIKRA-D** is a single board ALTAIR/IMSAI compatible memory configurable from 4K to 16K bytes in steps of 4K bytes. Our 16K memory is unique in the hobbyist/education field because it allows expansion to full 8080 address capability in only 4 slots.

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SIZE: 5" high x 10" wide (ALTAIR size)

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WEIGHT: 0.5 lb.

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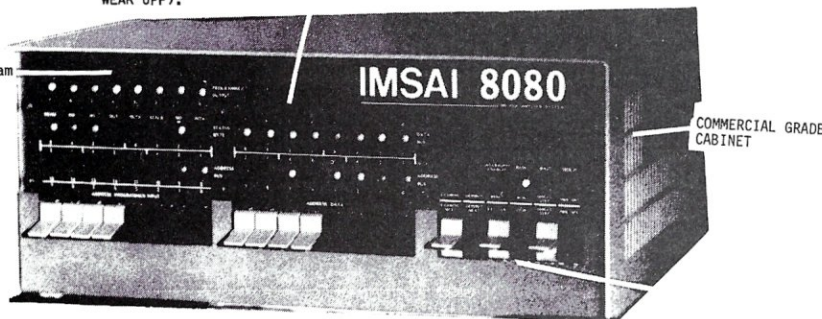
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FIRST MONTH-

- * IMSAI 8080 Microcomputer System User's Manual
- * INTEL 8080 Manual completely describing the IC's used and the instruction set....
- * An Introduction to Microcomputers a fundamental textbook...
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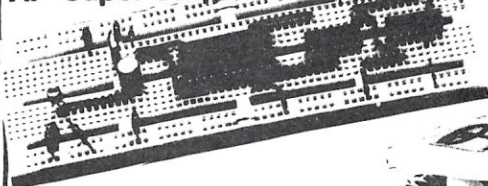
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SOFTWARE SECTION

Edited by Robert Stevens

SOFTWARE SECTION SECOND STEP

This issue takes the second step forward in establishing a totally devoted Software Section covering Microcomputer software. This issue includes 9 all meat, no fat programs covering memory diagnostics, math routines and microcomputer games.

Three memory diagnostic programs, two by Gary Kay of SWTPC for the 6800 and one by T. W. Travis for the 8080 should help keep your Microcomputer up and running. Gary Kay also provides a 6800 memory HEX dump utility program for those microcomputerists using a TTY or serial video control terminal.

Four small routines, one revised floating point math package for the 6502 by Roy Rankin and Steven Wozniak and two double precision multiplication routines + one 16 bit divide routine by Motorola for the M6800 provide calculator functions for your Microcomputer.

For those microcomputerists that enjoy games, Ed Keith's MICO BASIC Blackjack program for the 6800 provides real Vegas style blackjack with 1 to 4 decks of cards.

COMMERCIAL MANUFACTURERS SUPPORT PUBLIC DOMAIN SOFTWARE

Two commercial manufacturers, Motorola and Southwest Technical Products (SWTPC) provided six out of the total of nine software programs published in this month's issue of the INTERFACE AGE. Hard copy object-source listings, and in addition punched paper tape source listings were supplied for all six software programs for deposit in the Microcomputer Software Depository for public domain distribution. This attitude of supporting the emerging Microcomputer technology by free technical exchange of design and software information solves the age old problem of market acceptance of a new technology product. Commercial manufacturers providing the free exchange of detailed microcomputer mechanization concepts, logic dia-

grams and software programs benefit in a larger share of the future market as evidenced by our past history. Looking backward at our historic electronic technology, those manufacturers that first supported the circuit application of transistors and later on supported the application of the digital and analog IC's became the electronic giants of today's market place. We need more leaders like Motorola and SWTPC to support the free exchange of microcomputer software programs.

BEST ARTICLE OF THE MONTH AWARD

Starting in the December issue, INTERFACE AGE will bestow an Honorary Award of \$100.00 to the author of the best non-commercial Microcomputer article of the month. Only individuals are eligible for this monthly honorarium. This monthly award is in addition to the honorarium given on the page count basis. Microcomputer articles may be on hardware, software or a combination hardware software and will be judged by the INTERFACE AGE readership. Each INTERFACE AGE magazine shall include one original bingo voting card. Each individual possessing a bingo voting card shall be allowed up to ten votes to be cast as a total single vote block for one author or subdivided into any vote block segment size combinations, with the total cast vote sum not to exceed ten, cast between two or more authors (no xerox copies of the bingo vote card please). All valid bingo vote cards must be post-marked prior to 12:00 PM of the last day of the month following the issue date of the related magazine.

Why not sit down and start or finish that hardware or software design article you have been thinking about for some time now. Just maybe, your concept is just what everyone else has been looking for, and if so, just maybe the readership will vote your article the best article of the month award.

SOFTWARE SHOPPING LIST

Now that INTERFACE AGE has expanded the Microcomputer software coverage and developed a large appetite for good software, your programs and application software is badly needed to quench this enlarged software appetite. This software shopping list includes the following:

- **MICROCOMPUTER DEVELOPMENT SOFTWARE** such as assemblers, disassemblers, editors, monitors, utilities, mini-maxi BASIC interpreters & compilers, FORTRAN interpreters & compilers, boot strap loaders, software drivers, cassette software operating systems (COS), floppy disc software operating systems (FDOS), TTY software operating systems (TTYOS), and CRT software operating systems (CRTOS) for all Microcomputer configurations.
- **SHORT SOFTWARE ROUTINES** such as math packages and I/O diagnostics for all Microcomputer configurations.
- **APPLICATION SOFTWARE PROGRAMS** such as Analog To Digital Converter (DAC) — Digital to Analog Converter (DAC) software control programs, Automated membership billing and mailing list update program, Inventory control software, Invoice and billing software, Accounts Receivables and Payable software, Process control programs etc. for all Microcomputer configurations.
- **SOFTWARE COMMUNICATIONS PROTOCOL PROGRAMS** for such communication protocols as the BSC or Bisync (Binary Synchronous communication protocol procedures) and the new SDLC (Synchronous Data Link Control communication protocol procedures), etc.
- **OFF-LINE SOFTWARE STORAGE FORMAT CONTROL PROGRAMS** for cassette, paper tape, and floppy disc software recording formats.
- **MICROCOMPUTER GAME PROGRAMS**
- **ADD YOUR OWN PROGRAM SHOPPING LIST HERE** (Send your list to the Software Editor)

INTERFACE AGE WILL PUBLISH YOUR SOFTWARE

INTERFACE AGE is continually soliciting original unpublished quality documented highly commentated source - object code software listings and software technical articles for publishing in the INTERFACE AGE. Manuscript text must be typed double spaced with wide margins. Figures, tables, flow diagrams and charts must be numbered and submitted on separate sheets of white bond paper. Program listings must be printed on white clean paper using a new black ink ribbon, and please if possible, supply a punched paper tape source - object code listing + object dump with your hard copy. Be sure to record your name, company and office + home telephone numbers on all material submitted to the Software Editor. Include a prepaid post-

age stamped envelope with your return address only if you want your manuscript returned in the event that the submitted article is not accepted for publication.

Articles accepted and published will receive an honorary recognition award. Honorariums are based upon technical content, manuscript preparation and subject suitability for publication in INTERFACE AGE. Honorariums range from \$15.00 to \$30.00 per typeset magazine page. In addition, starting with the December issue, the best article of the month submitted will receive a \$100 bonus. INTERFACE AGE's readership will determine by vote which is the best article. All software submitted to INTERFACE AGE will be deposited in the Microcomputer Software Depository (MSD) for low cost distribution.

Address all software correspondence to R. A. Stevens, Software Editor c/o INTERFACE AGE Magazine, 2361 E. Foothill Blvd., Pasadena, CA. 91107 or call (213) 449-1655.

INEXPENSIVE MICROCOMPUTER SOFTWARE

The Microcomputer Software Depository (MSD) will act as repository for source and object code tapes. Programmers wishing to contribute programs to the public domain but who do not want to bother with distribution, may do so by forwarding appropriate documentation including short descriptive write-up and punch paper tape copy of program if possible or cassette copy to MSD. There is no membership fee for access to the public domain paper tapes (PDT) from MSD. Anyone may obtain copies of these PDT software packages by prepaying a small fee with the order to cover duplication, postage and handling cost. Prices will be listed periodically in INTERFACE AGE. Typical cost for a short program will be approximately \$2.00, including tax, postage and handling. As a convenience MSD will also provide punched paper tape copies of vendor supplied software packages (VSP) that will be sold at vendor suggested sale prices. Support MSD to build a software library by sending copies of your documented software programs including short description, flow diagrams and punched paper tape source code and object listings if possible or cassette tape copy for low cost distribution to the following address:

Microcomputer Software Depository
2361 E. Foothill Blvd.
Pasadena, CA 91107
(213) 449-0616.

HAPPY THANKSGIVING!

SWTPC 6800 Rotating Bit RAM Memory Diagnostic ROBIT-1 By Gary Kay

Southwest Technical Products Corporation

This rotating bit memory diagnostic program is designed to check for and locate memory retaining problems in the SWTPC 6800 Computer System memory boards, MP-M/MP-MX. The program itself uses 85₁₀ words and is meant to be loaded within the 128 word RAM used by the MIKBUG® operating system on the MP-A Microprocessor/System board. This makes the program independent of the MP-M/MP-MX RAM memory. The diagnostic may be loaded from either tape or from the terminal instruction by instruction using MIKBUG® starting from address A014₁₆ thru A07A₁₆. The program must be loaded in two parts to avoid interfering with the system's push-down stack located at Memory address A042 through and including A049. The contiguous section of memory to be tested is set by loading the most significant byte of the lower memory address into A002₁₆, the least significant byte of the lower memory address into A003₁₆, the most significant byte of the upper memory address into A004₁₆, and the least significant byte of the upper memory address into A005₁₆ using MIKBUG® just as is done for MIKBUG® punch routine. The lower and upper addresses are inclusive and may be any addresses between 0000₁₆ and FFFF₁₆ with the only requirement that the lower address be less than or equal to the upper address. Since addresses A07B₁₆ thru A07F₁₆ of the MIKBUG® RAM are still available for program use, the diagnostic may be run on these locations just to make sure the diagnostic itself is functioning correctly. Since the program counter is set when the program is initially loaded, the routine is initiated after loading by entering S9 or resetting the Microcomputer. The MIKBUG® operating system will gain program control and the terminal will respond with a carriage return (CR), a line feed (LF) and an asterisk*. The MIKBUG® operating system is now ready for an input command. Now enter the command control character G after the asterisk. Program control is now transferred to the user's ROBIT-1 program.

Once initiated, the program may then be re-started after setting the program counter to A018₁₆ at A048 and A049 by entering the control character M. Now enter the first 4 hexadecimal character address A048. The terminal will respond with a space and current memory contents (in hexadecimal) of this memory address followed with a space. Now enter the new data A0. Repeat this memory exchange process to enter memory data 18 into memory address 0049. Now enter the GO TO command control character G and MIKBUG® will return control back to the user's pro-

gram.

The diagnostic program starts from the lower address and loads that address with a binary 0000 0001 or 01₁₆. The data in this location is then read and verified. If accurate, the "one" bit is shifted left to form a binary 0000 0010 or 02₁₆ and is then again tested. This shift left sequence continues until a binary 1000 0000 or 80₁₆ has been loaded and verified, at which time the entire sequence is repeated at the next sequential memory address. This sequence continues until the selected upper memory address is reached. The program then prints a "+" on the control terminal to indicate cycle completion and proceeds to repeat itself. The program loops forever and may be exited when desired by depressing the "RESET" switch which returns control back to the MIKBUG® operating system program. When an error is detected, the memory address followed by what data should have been followed by what the memory data was, are printed out on the control terminal in hexadecimal (base 16) form. Example:

```
*0110    02    00
```

This example shows that memory address 0110, which is located in the first 1,024 words of RAM memory, was loaded with a binary 0000 0010 (02₁₆), but when read back contained a binary 0000 0000 (00₁₆) which indicates a possible problem in the 2¹ bit memory chip in the lower 1,024 words of memory or a possible problem in the 2¹ bit of the memory board data transceiver or a variety of other possibilities. The best way to tell for sure is to look for a pattern in the indicated errors. Take note that once one bit error has been located at a specific memory address, the one error is printed in the form shown above and the program increments to the next address without searching for more errors in the already defective address.

If you wish to eliminate the cyclic printout of the "+" sign you can do so by changing the data in address locations A076, A077 and A078 to NOP instructions (01₁₆) using MIKBUG®. This way you only get a printout of the error locations; that is if there are any. The running time of this program is very fast. It will cycle thru 2,048 words of memory in less than one second.

— SEE MICROCOMPUTER SOFTWARE
DEPOSITORY PROGRAM INDEX FOR COPIES
OF THIS PROGRAM

PROGRAM NAME: SWTPC 6800 ROTATING BIT RAM MEMORY DIAGNOSTIC ROUTINE

SYMBOLIC NAME: ROBIT-1

STORAGE REQUIREMENTS: 85 BYTES

PROGRAMMER: GARY KAY

SOUTHWEST TECHNICAL PRODUCTS CORPORATION

MICROCOMPUTER: SWTPC 6800

I/O INTERFACE EQUIPMENT: ASR 33 TTY OR SERIAL VIDEO

REQUIRED SUPPORTING SOFTWARE: MIKBUG OPERATING SYSTEM

ADDR	CODE	OBJECT LABEL	OP CODE	OPERAND	COMMENTS
A014			ORG	\$A014	
A014	00	INXMSB	FCB	\$00	
A015	00	INXLSB	FCB	\$00	
A016	00	ACCA	FCB	\$00	
A017	2B	PLUS	FCC	+	
A018	FE A002	ROBIT	LDX	#LOTEMP	LOAD TEST START ADDRESS IN IR
A01B	86 01	LODREG	LDAA	#1	LOAD A 1 IN THE A REG
A01D	A7 00		STAA	0,X	STORE A REG AT TEST ADDRESS
A01F	A1 00		CMPA	0,X	TEST TO SEE IF STORE WAS OK
A021	26 0D		BNE	ERRPNT	BRANCH IF NOT
A023	48	LOOP1	ASLA		SHIFT A REG 1 BIT TO LEFT
A024	68 00		ASLA	0,X	SHIFT DATA AT TEST ADDRESS 1 BIT TO LEFT
A026	A1 00		CMPA	0,X	TEST TO SEE IF STILL EQUAL TO A REG
A028	26 06		BNE	ERRPNT	BRANCH IF NOT
A02A	81 80		CMPA	#\$80	HAVE WE TESTED EACH BIT POSITION
A02C	26 F4		BNE	LOOP1	BRANCH IF NOT
A02E	20 3B		BRA	INCR1	BRANCH TO ADDRESS INCR ROUTINE
A030	FF A014	ERRPNT	STX	INXMSB	SAVE IR, IT POINTS TO ERROR BYTE
A033	CE E19D		LDX	#MCL	LOAD IR WITH ADDRESS OF CR LF
A036	20 12		BRA	CONTIN	BRANCH AROUND STACK AREA
A048			ORG	\$A048	
A048	A018		FDB	#ROBIT	START ADDRESS OF PROGRAM
A04A	B7 A016	CONTIN	STAA	ACCA	SAVE A REG
A04D	BD E07E		JSR	PDATA1	PRINT CR LF
A050	CE A014		LDX	#INXMSB	LOAD IR WITH ADDRESS OF ERROR BYTE
A053	BD E0C8		JSR	OUT4HS	PRINT ADDRESS FOLLOWED BY A SPACE
A056	CE A016		LDX	#ACCA	LOAD IR WITH ADDRESS OF SAVED A REG
A059	BD E0CA		JSR	OUT2HS	PRINT SAVED DATA (SHOULD HAVE BEEN)
A05C	FE A014		LDX	INXMSB	LOAD IR WITH ADDRESS OF BAD DATA
A05F	BD E0CA		JSR	OUT2HS	PRINT BAD DATA (WAS)
A062	CE E19D		LDX	#MCL	LOAD IR WITH ADDRESS OF CR LF
A065	BD E07E		JSR	PDATA1	PRINT CR LF
A068	FE A014		LDX	INXMSB	LOAD IR WITH ADDRESS OF TEST BYTE
A06B	BC A004	INCR1	CPX	HITEMP	ALL DONE?
A06E	27 03		BEQ	FINISH	BRANCH IF YES
A070	08		INX		IF NOT INCR IR BY 1
A071	20 A8		BRA	LODREG	BRANCH TO TEST NEXT BYTE
A073	B6 A017	FINISH	LDAA	PLUS	LOAD PLUS SIGN IN A REG
A076	BD E1D1		JSR	OUTEEE	PRINT PLUS SIGN
A079	20 9D		BRA	ROBIT	DO IT AGAIN!
	E19D	MCL	EQU	\$E19D	CR LF IN MIKBUG
	E07E	PDATA1	EQU	\$E07E	STRING OUTPUT ROUTINE IN MIKBUG
	E0C8	OUT4HS	EQU	\$E0C8	PRINT 4 HEX CHAR + A SPACE
	E0CA	OUT2HS	EQU	\$E0CA	PRINT 2 HEX CHAR + A SPACE, MIKBUG
	E1D1	OUTEEE	EQU	\$E1D1	OUTPUT 1 CHARACTER, MIKBUG
	A002	LOTEMP	EQU	\$A002	TEST START ADDRESS
	A004	HITEMP	EQU	\$A004	TEST END ADDRESS
					END

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CIRCLE NO. 54 ON INQUIRY CARD

VECTORED FROM PAGE 10

- Minnesota Computer Society, Box 35317, Mpls., MN 55435
- Nov. 26 Amateur Computer Group of New Jersey. 6800/6500 Users Group meets at 7 p.m. Union County Technical Institute, Scotch Plains, N.J.
- Nov. 26 Homebrew Computer Club, meets at 7 p.m. Stanford Accelerator Center Auditorium
- Dec. 1 New England Computer Society, 7 p.m. at Mitre Corp., near Routes 3 and 62 in Bedford, MA.
- Dec. 3 Amateur Computer Group of New Jersey 8080/Z80 Users Group meets at 7 p.m., Union County Technical Institute, Scotch Plains, N.J.
- Dec. 10 Homebrew Computer Club meets 7 p.m., Stanford Linear Accelerator Center Auditorium.
- Dec. 13 The Minnesota Computer Society will meet at 7:30 p.m. at Roseville Towers, Highway 36 and Fairview Avenue, Roseville, MN. 50 terminals are currently installed there and will be available for use by members that evening. For further information concerning the MCS contact: Minnesota Computer Society, Box 35317, Minneapolis, MN 55435.
- Dec. 17 Amateur Computer Group of New Jersey. Meeting at 7 p.m. Middlesex County College, in Edison, N.J.

- Dec. 19 The Cleveland Digital Group meets at 2 p.m., 8700 Harvard Ave., Cleveland, Ohio.
- Dec. 22 Homebrew Computer Club meets 7 p.m., Stanford Linear Accelerator Center Auditorium.

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Tax Applications
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SWTPC 6800 Short Memory Address Convergence MEMCON-1

By Gary Kay

Southwest Technical Products Corporation

This Memory Convergence diagnostic program is one designed to check for and locate address convergence problems in the SWTPC 6800 Computer System memory boards, MP-M/MP-MX. The program itself uses 56₁₀ words and is meant to be loaded within the 128 word RAM used by the MIKBUG® operating system on the MP-A Microprocessor/System board; making the program independent of the MP-M RAM memory. The diagnostic may be loaded from either tape or from the terminal instruction by instruction using MIKBUG® starting from address A014₁₆ thru A034₁₆ and then from address A048₁₆ thru A05E₁₆. The program must be loaded in two parts to avoid interfering with the system's push-down stack located at memory addresses A042 through and including A049. The section of memory to be tested is set by loading the most significant byte of the lower memory address into A002₁₆, the least significant byte of the lower memory address into A003₁₆, the most significant byte of the upper memory address into A004₁₆, and the least significant byte of the upper memory address into A005₁₆ using MIKBUG®. The lower and upper addresses are inclusive and may be any addresses between 0000₁₆ and FFFF₁₆ with the only requirement that the lower address be less than or equal to the upper address. Since addresses A05F₁₆ thru A07F₁₆ of the MIKBUG® RAM are still available for program use, the diagnostic may run on these locations just to make sure the diagnostic itself is functioning correctly. Since the program counter is set when the program is initially loaded, the routine is initiated after loading by either entering S9 or resetting the Microcomputer. The MIKBUG® operating system will gain program control and the terminal will respond with a carriage return (CR), a line feed (LF) and an asterisk (*). The MIKBUG® control program is now ready for an input command. Now enter the GO TO command control character G after the asterisk. Program control is now transferred to the user's program MEMCON-1.

Once initiated, the program can be stopped only by depressing the "RESET" button. MIKBUG® will gain program control and the terminal will respond with a CR LF and *. The MIKBUG® control program is now ready for a MIKBUG® input command. The program may then be re-started after setting the program counter to A015₁₆

at A048 and A049 by entering the memory inspect command control character M. The terminal will respond with a space (SP) after M. Now enter the first 4 hexadecimal character address A048. The terminal will respond with a space and current hexadecimal contents of this memory address followed with a space. Now enter the new data A0. Repeat this memory exchange process to enter 15 into memory address 0049. Now enter the GO TO command control character G and MIKBUG® will return control back to the user's program.

The test diagnostic program starts by loading a continuous stream of 256 sequential binary numbers from the low memory address to the high memory address, inclusive. The test program then goes back and sequentially reads the data in each of the locations and compares it to what actually should be there. If it finds any discrepancies within the memory cycle, one X is printed and the cycle is re-started, otherwise a # is printed to indicate successful cycle completion. Since the actual location of any detected errors does not point to the source of the problem, no provision is made for indicating the addresses of detected errors. It must also be noted that the program is not 100% effective. It would be possible to set bits in multiple locations that coincidentally would have been set anyway. However, each cycle puts different data in each memory location, so the possibility of a missed problem are reduced. The test program loops forever and may be exited when desired by depressing the "RESET" switch which returns control back to the MIKBUG® program.

If you wish to eliminate the cyclic printout of the "#" sign you can do so by changing the data in address locations A059, A05A and A05B to NOP instructions (01₁₆) using MIKBUG®. This way you only get a printout of the error cycles, if any.

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DEPOSITORY PROGRAM INDEX FOR COPIES
OF THIS PROGRAM

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CIRCLE NO. 57 ON INQUIRY CARD

Memory Address Assignment Table (Hex)

Board #	Memory Quadrant (K of memory)	Starting Addr.	Ending Addr.
0	1	0000	03FF
	2	0400	07FF
	3	0800	0BFF
	4	0C00	0FFF
1	1	1000	13FF
	2	1400	17FF
	3	1800	1BFF
	4	1C00	1FFF
2	1	2000	23FF
	2	2400	27FF
	3	2800	2BFF
	4	2C00	2FFF
3	1	3000	33FF
	2	3400	37FF
	3	3800	3BFF
	4	3C00	3FFF
4	1	4000	43FF
	2	4400	47FF
	3	4800	4BFF
	4	4C00	4FFF
5	1	5000	53FF
	2	5400	57FF
	3	5800	5BFF
	4	5C00	5FFF
6	1	6000	63FF
	2	6400	67FF
	3	6800	6BFF
	4	6C00	6FFF
7	1	7000	73FF
	2	7400	77FF
	3	7800	7BFF
	4	7C00	7FFF

MP-M/MP-MX Memory IC Assignment Map

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Quadrant 1 (1K) IC15	IC13	IC11	IC9	IC7	IC5	IC3	IC1	
Quadrant 2 (2K) IC16	IC14	IC12	IC10	IC8	IC6	IC4	IC2	
Quadrant 3 (3K) IC40	IC38	IC36	IC34	IC32	IC30	IC28	IC26	
Quadrant 4 (4K) IC39	IC37	IC35	IC33	IC31	IC29	IC27	IC25	

00 hex = 0000 0000 binary

01 hex = 0000 0001 binary

02 hex = 0000 0010 binary

04 hex = 0000 0100 binary

08 hex = 0000 1000 binary

10 hex = 0001 0000 binary

20 hex = 0010 0000 binary

40 hex = 0100 0000 binary

80 hex = 1000 0000 binary

PROGRAM NAME: SWTPC 6800 SHORT MEMORY ADDRESS CONVERGENCE ROUTINE

SYMBOLIC NAME: MEMCON-1

STORAGE REQUIREMENTS: 56 BYTES

PROGRAMMER: GARY KAY

SOUTHWEST TECHNICAL PRODUCTS CORPORATION

MICROCOMPUTER: SWTPC 6800

I/O INTERFACE EQUIPMENT: ASR 33 TTY OR SERIAL VIDEO

REQUIRED SUPPORTING SOFTWARE: MIKBUG OPERATING SYSTEM

OBJECT	OP				
ADDR CODE	LABEL	CODE	OPERAND	COMMENTS	
A002		ORG	\$A002		
A002	LOMEM	FDB		STARTING ADDRESS OF TEST BLOCK	
A004	HIMEM	FDB		ENDING ADDRESS OF TEST BLOCK	
A014		ORG	\$A014	BYPASS DATA AREAS USED BY MIKBUG	
A014	BSTORE	RMB		STORAGE FOR B REG	
	*				
	*			MEMORY LOAD PHASE	
	*				
A015 F7	A014 MEMCON	STAB	BSTORE	SAVE B REG	
A018 FE	A002	LDX	LOMEM	LOAD IR WITH LOW TEST ADDRESS	
A01B E7	00 LOOP1	STAB	0,X	STORE B REG AT TEST ADDRESS	
A01D BC	A004	CPX	HIMEM	TEST DONE?	
A020 27	04	BEQ	CHECK	BRANCH TO TEST PHASE IF LOAD DONE	
A022 08		INX		INCR THE IR	
A023 5C		INCB		INCR THE B REG	
A024 20	F5	BRA	LOOP1	CONTINUE LOAD PHASE	
	*				
	*			MEMORY TEST PHASE	
	*				
A026 F6	A014 CHECK	LDAB	BSTORE	RESTORE B REG	
A029 FE	A002	LDX	LOMEM	RESTORE IR WITH TEST ADDRESS	
A02C E1	00 LOOP2	CMPB	0,X	DOES DATA AT TEST ADDR = B REG	
A02E 26	20	BNE	ERROR	BRANCH IF NOT	
A030 BC	A004	CPX	HIMEM	TEST DONE?	
A033 20	15	BRA	CONTIN	BRANCH AROUND STACK AREA	
A048		ORG	\$A048		
A048 A015		FDB	#MEMCON	DEFINE START ADDRESS OF PROGRAM	
A04A 27	0B CONTIN	BEQ	CYCLE	BRANCH IF DONE	
A04C 08		INX		INCR THE IR	
A04D 5C		INCB		INCR THE B REG	
A04E 20	DC	BRA	LOOP2	CONTINUE THE TEST PHASE	
A050 86	58 ERROR	LDAA	#'X	PRINT THE CHARACTER "X"	
A052 BD	E1D1	JSR	OUTEEE	TO SHOW AN ERROR AND	
A055 20	BE	BRA	MEMCON	RESTART THE TEST	
A057 86	23 CYCLE	LDAA	#'#	PRINT A POUND SIGN TO	
A059 BD	E1D1	JSR	OUTEEE	SHOW TEST WAS OK	
A05C 5A		DECB		DECR THE B REG AND	
A05D 20	B6	BRA	MEMCON	RESTART THE TEST	
E1D1	OUTEEE	EQU	\$E1D1	DEFINE ADDR OF OUTEEE	
		END			

SWTPC 6800 Memory Dump Program MEMDMP-1

By Gary Kay

Southwest Technical Products Corporation

This memory dump program allows one to display or print the contents of specified half page (128₁₀ word) blocks of computer memory on the serial video control terminal or teletypewriter. The data is displayed in hexadecimal form with sixteen lines of eight bytes of data per line. The starting address of each data line is printed at the beginning of each of the sixteen lines for easy identification. Once a block of data has been selected and is being displayed, a simple one character commands allow one to select and display the 128 word block of data immediately preceding or following the block being displayed. A three character entry allows the user to reselect and display a 128 word block of data located anywhere in computer memory.

The program itself consumes 91₁₀ words of memory and is meant to be loaded within the 128 word RAM used by the MIKBUG® operating system on the MP-A Microprocessor/System board. This makes the program totally independent of the MP-M/MP-MX RAM memory boards where programs and data are normally stored. The MEMDMP program may be loaded from either tape or from the control terminal, instruction by instruction using MIKBUG® starting from address A014 thru A07F. The program must be loaded in two parts to avoid interfering with the system's push-down stack located at memory addresses A042 through and including A049. Since the program counter is set when the program is initially loaded, the routine is initiated after loading by entering S9 or resetting the Microcomputer. The MIKBUG® operating system will gain program control and the terminal will respond with a carriage return (CR), a line feed (LF) and an asterisk (*). The MIKBUG® operating system is now ready for an input command. Now enter the character G after the asterisk. Program control is now transferred to the user's MEMDMP-1 program. Once initiated, the program can be stopped only by depressing the "RESET" button. MIKBUG® will gain program control and the terminal will respond with a CR LF and *. The MIKBUG® operating system is now ready for a MIKBUG® input command. The program may then be re-started after setting the program counter to A01A₁₆ at A048 and A049 by entering the control character M. The terminal will respond with a space after M. Now enter the first 4 hexadecimal character address A048. The terminal will respond with a space and current contents (in hex-

adecimal) of this memory address followed with a space. Now enter the new data A0. Repeat this memory exchange process to enter 1A into memory address 0049. Now enter the character G and MIKBUG® will return control back to MEMDMP-1.

Once the program is initiated you should enter the character "N" followed by the most significant hexadecimal byte of the memory address block you wish to display. The other two commands which the program will respond to are "F" to display the next forward memory block and "B" to display the adjacent backward memory block. Any of these commands may be entered at the completion of a memory block display. The program will work with either a teletypewriter or video terminal system. Control characters 10₁₆ and 16₁₆ are sent out by the program to perform home-up and erase to end-of-frame functions on those systems using the SWTPC CT-1024 terminal system with the CT-CA Computer Controlled Cursor option. The following is a typical display:

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*G N00

0000	FF	7F	3F	FF	BF	FB	DF	DA
0008	5F	D9	5F	DB	3F	FB	7B	7B
0010	3F	DD	7D	79	6D	5F	3F	1B
0018	3F	1F	3F	9F	3F	9F	DF	FF
0020	BF	BB	BF	B3	BF	D3	BF	FB
0028	BF	DB	BF	D3	DF	DB	F7	F3
0030	BF	FB	B7	FB	FF	D3	1F	F3
0038	1F	DB	FF	DB	9F	D7	8B	FF
0040	FF	F7	FF	DB	FF	F3	BD	DD
0048	6F	DF	7F	9B	9F	DB	BD	DB
0050	3F	DB	BD	DD	DF	FF	3F	FF
0058	BF	FB	BF	DF	AF	FF	BF	FF
0060	AF	B3	BF	13	BF	9B	1F	93
0068	FF	DB	BF	9B	3F	9B	AD	93
0070	2F	DB	6F	FF	3F	DB	7E	DF
0078	3F	FB	77	F3	BF	FB	9F	FF F

SOFTWARE SECTION

MICROCOMPUTER DEVELOPMENT SOFTWARE

0080	EF	FF	BF	FF	9F	FF	FF	FB	0000	FF	7F	3F	FF	BF	FB	DF	DA
0088	3F	DB	BF	DF	3F	DF	FF	DF	0008	5F	D9	5F	DB	3F	FB	7B	7B
0090	BF	DB	BD	FF	FF	FF	DF	FB	0010	3F	DD	7D	79	6D	5F	3F	1B
0098	BF	FF	1F	FF	BF	FB	FF	FF	0018	3F	1F	3F	9F	3F	9F	DF	FF
00A0	FF	97	BF	D3	EF	93	AF	F3	0020	BF	BB	BF	B3	BF	D3	BF	FB
00A8	BF	D9	3F	93	3F	73	D7	DB	0028	BF	DB	BF	D3	DF	DB	F7	F3
00B0	3F	DB	37	F3	DB	DE	3F	F3	0030	BF	FB	B7	FB	FF	D3	1F	F3
00B8	3F	F3	BB	D3	2F	FB	2F	FF	0038	1F	DB	FF	DB	9F	D7	8B	FF
00C0	FF	FF	BF	DB	BF	DF	BF	7F	0040	FF	F7	FF	DB	FF	F3	BD	DD
00C8	3F	DF	BF	DB	ED	77	2F	FF	0048	6F	DF	7F	9B	9F	DB	BD	DB
00D0	2F	FF	BD	FB	5F	DF	3F	FF	0050	3F	DB	BD	DD	DF	FF	3F	FF
00D8	7F	FB	BF	FF	BD	FF	BF	FF	0058	BF	FB	BF	DF	AF	FF	BF	FF
00E0	FF	33	BF	B3	3F	D3	2F	D3	0060	AF	B3	BF	13	BF	9D	1F	93
00E8	7	B3	3F	9E	EF	D3	3F	F3	0068	FF	DB	BF	9B	3F	9B	AD	93
00F0	1B	B3	3F	B3	BF	DB	27	D2	0070	2F	DB	6F	FF	3F	DB	7E	DF
00F8	17	F3	OF	F3	37	DF	AF	FF	0078	3F	FB	77	F3	BF	FB	9F	FF

PROGRAM NAME: SWTPC 6800 MEMORY DUMP ROUTINE

SYMBOLIC NAME: MEMDMP-1

STORAGE REQUIREMENTS: 91 BYTES

PROGRAMMER: GARY KAY

SOUTHWEST TECHNICAL PRODUCTS CORPORATION

MICROCOMPUTER: SWTPC 6800

I/O INTERFACE EQUIPMENT: ASR 33 TTY OR SERIAL VIDEO

REQUIRED SUPPORTING SOFTWARE: MIKBUG OPERATING SYSTEM

PROGRAM COMMANDS: NXX - DISPLAY CONTENTS OF 128 WORD HALF PAGE
OF MEMORY BEGINNING AT XX00

F - AT END OF DISPLAY TYPE F TO GO TO
NEXT MEMORY BLOCK

B - AT END OF DISPLAY TYPE B TO BACK UP
ONE MEMORY BLOCK

ADDR	CODE	OBJECT LABEL	OP CODE	OPERAND	COMMENTS
A014			ORG	\$A014	
A014	0D	SETUP	FCB	\$0D	CARRIAGE RETURN
A015	0A		FCB	\$0A	LINE FEED
A016	0A		FCB	\$0A	LINE FEED
A017	10		FCB	\$10	HOME UP ON TERMINAL
A018	16		FCB	\$16	SCREEN CLEAR
A019	04		FCB	\$04	END OF TEXT
A01A	5F	MEMDMP	CLRB		ZERO B REG
A01B	37		PSHB		PUSH B REG ONTO STACK
A01C	BD	E1AC	JSR	INEEF	GET A CHARACTER
A01F	81	46	CMPA	#'F	WAS IT AN "F"
A021	27	30	BEQ	NEWFRM	BRANCH TO NEW FRAME IF YES
A023	81	42	CMPA	#'B	WAS IT A "B"
A025	26	23	BNE	SKIP1	IF NOT ASSUME AN "V"
A027	CE	A00C	LDX	#XHI	POINT IR TO ADDRESS OF DATA
A02A	4F		CLRA		CLEAR A REG
A02B	AB	01	ADDA	1,X	ADD TO A REG THE XLO VALUE

A02D A7 01	STAA	1,X	AND RESTORE IT TO SET CARRY FLAG	
A02F 86 FF	LDAA	#\$FF	LOAD A REG WITH HEX FF	
A031 A9 00	ADCA	0,X	A SNEAKY WAY TO SUBTRACT	
A033 A7 00	STAA	0,X	RESTORE XHI AS XHI - 1	
A035 20 1C	BRA	NEWFRM	JUMP TO PRINT NEW FRAME	
A048	ORG	\$A048		
A048 A01A	FDB	MEMDMP	DEFINE START ADDRESS OF PROGRAM	
A04A BD E055 SKIP1	JSR	BYTE	INPUT MSB OF ADDRESS	
A04D B7 A00C	STAA	XHI	STORE MSB OF ADDRESS	
A050 7F A00D	CLR	XLOW	CLEAR LSB OF ADDRESS	
A053 CE A014 NEWFRM	LDX	#SETUP	POINT TO SCREEN CLEAR CR LF STRING	
A056 BD E07E	JSR	PDATA1	AND OUTPUT IT	
A059 CE A00C OUTADR	LDX	#XHI	POINT TO ADDRESS OF OUTPUT LINE	
A05C BD E0C8	JSR	OUT4HS	AND PRINT IT FOLLOWED BY A SPACE	
A05F 5F	CLRB		CLEAR B REG (NO OF BYTES PRINTED)	
A060 FE A00C	LDX	XHI	PUT ADDRESS OF DATA IN IR	
A063 BD E0CA LOOP1	JSR	OUT2HS	PRINT BYTE IN HEX FOLLOWED BY SPACE	
A066 5C	INCB		ADD 1 TO NO OF BYTES PRINTED	
A067 C1 08	CMPB	#\$08	HAVE 8 BYTES BEEN PRINTED?	
A069 26 F8	BNE	LOOP1	BRANCH IF NOT	
A06B FF A00C	STX	XHI	SAVE IR FOR NEXT LINE	
A06E 33	PULB		LOAD B REG FROM STACK	
A06F 5C	INCB		ADD 1 TO B REG	
A070 C1 10	CMPB	#\$10	SEE IF 16 LINES PRINTED	
A072 27 A6	BEQ	MEMDMP	BRANCH IF YES	
A074 37	PSHB		PUSH INCREMENTED B REG ONTO STACK	
A075 CE A07D	LDX	#CRLF	LOAD IR WITH ADDRESS OF CR LF STRING	
A078 BD E07E	JSR	PDATA1	AND PRINT IT	
A07B 20 DC	BRA	OUTADR	BRANCH BACK TO PRINT ROUTINE	
A07D 0D	FCB	\$0D	CARRIAGE RETURN	
A07E 0A	FCB	\$0A	LIVE FEED	
A07F 04	FCB	\$04	END OF TEXT	
E1AC	INEEE	EQU	\$E1AC	INPUT ROUTINE IN MIKBUG
E055	BYTE	EQU	\$E055	BYTE INPUT ROUTINE IN MIKBUG
E07E	PDATA1	EQU	\$E07E	STRING OUTPUT ROUTINE IN MIKBUG
E0C8	OUT4HS	EQU	\$E0C8	PRINT 4 HEX CHAR + A SPACE, MIKBUG
E0CA	OUT2HS	EQU	\$E0CA	PRINT 2 HEX CHAR + A SPACE, MIKBUG
A00C	XHI	EQU	\$A00C	MSB OF ADDRESS TO START DUMP
A00D	XLO	EQU	\$A00D	LSB OF ADDRESS TO START DUMP

*
*
*
*
*
*
*

NOTE: IF YOU ARE USING A TTY OR 64 CHARACTER
OUTPUT TERMINAL CHANGE THE #\$08 OF THE
INSTRUCTION AT A067 TO #\$10. THIS WILL
PRINT 16 BYTES ON A LINE INSTEAD OF THE
MAXIMUM OF 8 WHICH CAN BE PRINTED ON A
TV TYPEWRITER TYPE TERMINAL

END

FLOATING POINT ROUTINES FOR 6502*

by Roy Rankin

DEPARTMENT OF MECHANICAL ENGINEERING, STANFORD UNIVERSITY

and Steve Wozniak

APPLE COMPUTER CO.

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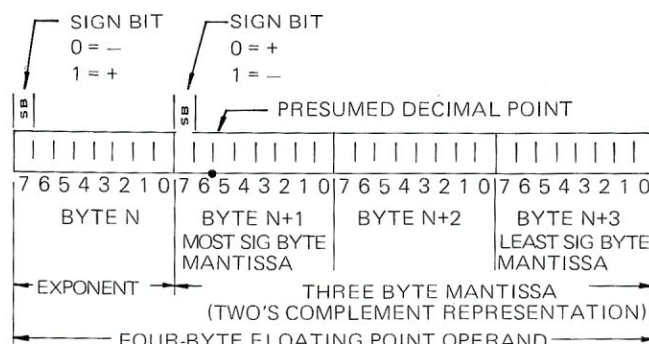
The following floating point routines represent a joint effort between Steve Wozniak who wrote the basic floating point routines of FADD, FSUB, FMUL, FDIV and their support routines and myself, Roy Rankin, who added FIX, FLOAT, LOG, LOG10, and EXP. The basic floating point routines are fairly Machine dependent, but the transcendental programs should be very easy to transport from one machine to another. The routines consist of the following math functions

- LOG Natural log
- LOG10 Base 10 log
- EXP Exponential
- FADD Floating add
- FSUB Floating subtraction
- FMUL Floating multiplication
- FDIV Floating division
- FIX Convert floating to fixed
- FLOAT Convert fixed to floating

Two additional routines exchange the contents of exp/mant1 with exp/mant2 and compliments exp/mant1. These routines are:

SWAP Exchange the contents of exp/mant 1 with exp/mant 2
FCOMPL Complement exp/mant 1

Floating point numbers are represented by 4 bytes as shown in the following



The exponent byte is a binary scaling factor for the Mantissa. The exponent is a standard two's complement representation except that the sign bit is complemented and runs from +128 to +127. For example:

```
$00 is -128
$01 is -127
      •
      •
$7F is -1
$80 is 0
$81 is +1
      •
      •
$FF is 127
```

The mantissa is standard two's complement representation with the sign bit in the most significant bit of the high order byte. The assumed decimal point is between bits 6 and 7 of the most significant byte. Thus the normalized mantissa ranges in absolute value from 1 to 2. Except when the exponent has a value of +128 the mantissa is normalized to retain maximum precision. The mantissa is normalized if the upper two bits of the high-order mantissa byte are unequal. Thus a normalized mantissa is of the following form:

```
01. xxxxxx    positive mantissa (high byte)
10. xxxxxx    negative mantissa (high byte)
Assumed binary point
```

Some Sample floating point numbers in hex

```
83 50 00 00    10.
80 40 00 00    1.
7C 66 66 66    .1
00 00 00 00    0.
FC 99 99 9A    -.1
7F 80 00 00    -1.
83 B0 00 00    -10.
```

The routines are all entered using a JSR instruction. Base page locations \$0004-\$0007 are referred to as exp/mant2 while \$0008-\$000B are referred to as exp/mant1 and act as floating point registers. On entry to the subroutines these registers contain the numbers to be operated upon and contain the result on return. The function of the registers is given before each entry point in the source listing. There are three error traps which will cause a software interrupts. ERROT (1D06) is encountered if the argument in the log routine is less than or equal to zero. OVFLW (1E3B) will be executed if

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the argument of EXP is too large. Overflow detected by the basic floating point routines will cause OVFL (1FE4) to be executed. The routines do not give underflow errors, but set the number to zero if underflow occurs.

Readers of Dr. Dobb's journal should note that when these routines were published in that journal the math function LOG contained an error which prevented the

correct result from being given if the argument was less than 1. This error has been corrected in the present listing and marked with "MOD 9/76."

SEE MICROCOMPUTER SOFTWARE DEPOSITORY PROGRAM INDEX FOR COPIES OF THIS PROGRAM

END PASS 1

0 ERRORS

```

1      *          SEPTEMBER 11, 1976
2      *          BASIC FLOATING POINT ROUTINES
3      *          FOR 6502 MICROPROCESSOR
4      *          BY R. RANKIN AND S. WOZNIAK
5      *
6      *          CONSISTING OF:
7      *          NATURAL LOG
8      *          COMMON LOG
9      *          EXPONENTIAL (E**X)
10     *          FLOAT      FIX
11     *          FADD      FSUB
12     *          FMUL      FDIV
13     *
14     *
15     *          FLOATING POINT REPRESENTATION (4-BYTES)
16     *          EXPONENT BYTE 1
17     *          MANTISSA BYTES 2-4
18     *
19     *          MANTISSA:  TWO'S COMPLIMENT REPRESENTATION WITH SIGN IN
20     *          MSB OF HIGH-ORDER BYTE.  MANTISSA IS NORMALIZED WITH AN
21     *          ASSUMED DECIMAL POINT BETWEEN BITS 5 AND 6 OF THE HIGH-ORDER
22     *          BYTE.  THUS THE MANTISSA IS IN THE RANGE 1. TO 2. EXCEPT
23     *          WHEN THE NUMBER IS LESS THAN 2**(-128).
24     *
25     *          EXPONENT:  THE EXPONENT REPRESENTS POWERS OF TWO.  THE
26     *          REPRESENTATION IS 2'S COMPLIMENT EXCEPT THAT THE SIGN
27     *          BIT (BIT 7) IS COMPLIMENTED.  THIS ALLOWS DIRECT COMPARISON
28     *          OF EXPONENTS FOR SIZE SINCE THEY ARE STORED IN INCREASING
29     *          NUMERICAL SEQUENCE RANGING FROM $00 (-128) TO $FF (+127)
30     *          ($ MEANS NUMBER IS HEXADECIMAL).
31     *
32     *          REPRESENTATION OF DECIMAL NUMBERS:  THE PRESENT FLOATING
33     *          POINT REPRESENTATION ALLOWS DECIMAL NUMBERS IN THE APPROXIMATE
34     *          RANGE OF 10**(-38) THROUGH 10**(38) WITH 6 TO 7 SIGNIFICANT
35     *          DIGITS.
36     *
37     *
38     0003      ORG 3          SET BASE PAGE ADRESSES
39     0003  EA    SIGN  NOP
40     0004  EA    X2    NOP          EXPONENT 2
41     0005  00 00 00  M2  BSS 3      MANTISSA 2
42     0008  EA    X1    NOP          EXPONENT 1
43     0009  00 00 00  M1  BSS 3      MANTISSA 1
44     000C      E      BSS 4      SCRATCH
45     0010      Z      BSS 4
46     0014      T      BSS 4
47     0018      SEXP  BSS 4
48     001C  00      INT  BSS 1
49     *
50     1D00      ORG $1D00      STARTING LOCATION FOR LOG
51     *
52     *          NATURAL LOG OF MANT/EXP1 WITH RESULT IN MANT/EXP1
53     *
54     1D00  A5 09      LOG      LDA M1

```


55	1D02	F0 02		BEW ERRUR	
56	1D04	10 01		BPL CONT	IF ARG>0 OK
57	1D06	00	ERROR	BRK	ERROR ARG<=0
58			*		
59	1D07	20 1C 1F	CONT	JSR SWAP	MOVE ARG TO EXP/MANT2
60	1D0A	A2 00		LDX =0	MOD 9/76: LOAD X FOR LATER
61	1D0C	A5 04		LDA X2	HOLD EXPONENT
62	1D0E	A0 80		LDY =\$80	
63	1D10	84 04		STY X2	SET EXPONENT 2 TO 0 (\$80)
64	1D12	49 80		EOR =\$80	COMPLIMENT SIGN BIT OF ORIGINAL EXPONENT
65	1D14	85 0A		STA M1+1	SET EXPONENT INTO MANTISSA 1 FOR FLOAT
66	1D16	10 01		BPL *+3	MOD 9/76: IS EXPONENT ZERO?
67	1D18	CA		DEX	MOD 9/76: YES SET X TO \$FF
68	1D19	86 09		STX M1	MOD 9/76: SET UPPER BYTE OF EXPONENT
69	1D1B	20 2C 1F		JSR FLOAT	CONVERT TO FLOATING POINT
70	1D1E	A2 03		LDX =3	4 BYTE TRANSFERS
71	1D20	B5 04	SEXP1	LDA X2,X	
72	1D22	95 10		STA Z,X	COPY MANTISSA TO Z
73	1D24	B5 08		LDA X1,X	
74	1D26	95 18		STA SEXP,X	SAVE EXPONENT IN SEXP
75	1D28	BD D4 1D		LDA R22,X	LOAD EXP/MANT1 WITH SQRT(2)
76	1D2B	95 08		STA X1,X	
77	1D2D	CA		DEX	
78	1D2E	10 F0		BPL SEXP1	
79	1D30	20 4A 1F		JSR FSUB	Z-SQRT(2)
80	1D33	A2 03		LDX =3	4 BYTE TRANSFER
81	1D35	B5 08	SAVET	LDA X1,X	SAVE EXP/MANT1 AS T
82	1D37	95 14		STA T,X	
83	1D39	B5 10		LDA Z,X	LOAD EXP/MANT1 WITH Z
84	1D3B	95 08		STA X1,X	
85	1D3D	BD D4 1D		LDA R22,X	LOAD EXP/MANT2 WITH SQRT(2)
86	1D40	95 04		STA X2,X	
87	1D42	CA		DEX	
88	1D43	10 F0		BPL SAVET	
89	1D45	20 50 1F		JSR FADD	Z+SQRT(2)
90	1D48	A2 03		LDX =3	4 BYTE TRANSFER
91	1D4A	B5 14	TM2	LDA T,X	
92	1D4C	95 04		STA X2,X	LOAD T INTO EXP/MANT2
93	1D4E	CA		DEX	
94	1D4F	10 F9		BPL TM2	
95	1D51	20 9D 1F		JSR FDIV	$T = (Z - \text{SQRT}(2)) / (Z + \text{SQRT}(2))$
96	1D54	A2 03		LDX =3	4 BYTE TRANSFER
97	1D56	B5 08	M1T	LDA X1,X	
98	1D58	95 14		STA T,X	COPY EXP/MANT1 TO T AND
99	1D5A	95 04		STA X2,X	LOAD EXP/MANT2 WITH T
100	1D5C	CA		DEX	
101	1D5D	10 F7		BPL M1T	
102	1D5F	20 77 1F		JSR FMUL	T*T
103	1D62	20 1C 1F		JSR SWAP	MOVE T*T TO EXP/MANT2
104	1D65	A2 03		LDX =3	4 BYTE TRANSFER
105	1D67	BD E4 1D	M1C	LDA C,X	
106	1D6A	95 08		STA X1,X	LOAD EXP/MANT1 WITH C
107	1D6C	CA		DEX	
108	1D6D	10 F8		BPL M1C	
109	1D6F	20 4A 1F		JSR FSUB	T*T-C
110	1D72	A2 03		LDX =3	4 BYTE TRANSFER
111	1D74	BD E0 1D	M2MB	LDA MB,X	
112	1D77	95 04		STA X2,X	LOAD EXP/MANT2 WITH MB
113	1D79	CA		DEX	
114	1D7A	10 F8		BPL M2MB	
115	1D7C	20 9D 1F		JSR FDIV	$MB / (T*T - C)$
116	1D7F	A2 03		LDX =3	4 BYTE TRANSFER
117	1D81	BD DC 1D	M2A1	LDA A1,X	


```

118 1D84 95 04          STA X2,X      LOAD EXP/MANT2 WITH A1
119 1D86 CA            DEX
120 1D87 10 F8          BPL M2A1
121 1D89 20 50 1F        JSR FADD      MB/(T*T-C)+A1
122 1D8C A2 03          LDX =3        4 BYTE TRANSFER
123 1D8E B5 14          M2T LDA T,X
124 1D90 95 04          STA X2,X      LOAD EXP/MANT2 WITH T
125 1D92 CA            DEX
126 1D93 10 F9          BPL M2T
127 1D95 20 77 1F        JSR FMUL      (MB/(T*T-C)+A1)*T
128 1D98 A2 03          LDX =3        4 BYTE TRANSFER
129 1D9A BD E8 1D        M2MHL LDA MHLF,X
130 1D9D 95 04          STA X2,X      LOAD EXP/MANT2 WITH MHLF (.5)
131 1D9F CA            DEX
132 1DA0 10 F8          BPL M2MHL
133 1DA2 20 50 1F        JSR FADD      +.5
134 1DA5 A2 03          LDX =3        4 BYTE TRANSFER
135 1DA7 B5 18          LDEXP LDA SEXP,X
136 1DA9 95 04          STA X2,X      LOAD EXP/MANT2 WITH ORIGINAL EXPONENT
137 1DAB CA            DEX
138 1DAC 10 F9          BPL LDEXP
139 1DAE 20 50 1F        JSR FADD      +EXPN
140 1DB1 A2 03          LDX =3        4 BYTE TRANSFER
141 1DB3 BD D8 1D        MLE2 LDA LE2,X
142 1DB6 95 04          STA X2,X      LOAD EXP/MANT2 WITH LN(2)
143 1DB8 CA            DEX
144 1DB9 10 F8          BPL MLE2
145 1DBB 20 77 1F        JSR FMUL      *LN(2)
146 1DBE 60             RTS           RETURN RESULT IN MANT/EXP1
147                      *
148                      * COMMON LOG OF MANT/EXP1 RESULT IN MANT/EXP1
149                      *
150 1DBF 20 00 1D        LOG10 JSR LOG      COMPUTE NATURAL LOG
151 1DC2 A2 03          LDX =3
152 1DC4 BD D8 1D        L10  LDA LN10,X
153 1DC7 95 04          STA X2,X      LOAD EXP/MANT2 WITH 1/LN(10)
154 1DC9 CA            DEX
155 1DCA 10 F8          BPL L10
156 1DCC 20 77 1F        JSR FMUL      LOG10(X)=LN(X)/LN(10)
157 1DCF 60             RTS
158                      *
159 1DD0 7E 6F          LN10 DCM 0.4342945
160 1DD4 80 5A          R22 DCM 1.4142136 SQRT(2)
161 1DD8 7F 58          LE2 DCM 0.69314718 LOG BASE E OF 2
162 1DDC 80 52          A1 DCM 1.2920074
163 1DE0 81 AB          MB DCM -2.6398577
164 1DE4 80 6A          C DCM 1.6567626
165 1DE8 7F 40          MHLF DCM 0.5
166                      *
167 1E00                ORG $1E00      STARTING LOCATION FOR EXP
168                      *
169                      * EXP OF MANT/EXP1 RESULT IN MANT/EXP1
170                      *
171 1E00 A2 03          EXP LDX =3        4 BYTE TRANSFER
172 1E02 BD D8 1E        LDA L2E,X
173 1E05 95 04          STA X2,X      LOAD EXP/MANT2 WITH LOG BASE 2 OF E

```


174	1E07	CH		DEX	
175	1E08	10 F8		BPL EXP+2	
176	1E0A	20 77 1F		JSR FMUL	LOG2(E)*X
177	1E0D	A2 03		LDX =3	4 BYTE TRANSFER
178	1E0F	B5 08	FSA	LDA X1,X	
179	1E11	95 10		STA Z,X	STORE EXP/MANT1 IN Z
180	1E13	CA		DEX	
181	1E14	10 F9		BPL FSA	SAVE Z=LN(2)*X
182	1E16	20 E8 1F		JSR FIX	CONVERT CONTENTS OF EXP/MANT1 TO AN INTEGER
183	1E19	A5 0A		LDA M1+1	
184	1E1B	85 1C		STA INT	SAVE RESULT AS INT
185	1E1D	38		SEC	SET CARRY FOR SUBTRACTION
186	1E1E	E9 7C		SBC =124	INT-124
187	1E20	A5 09		LDA M1	
188	1E22	E9 00		SBC =0	
189	1E24	10 15		BPL OVFLW	OVERFLOW INT>=124
190	1E26	18		CLC	CLEAR CARRY FOR ADD
191	1E27	A5 0A		LDA M1+1	
192	1E29	69 78		ADC =120	ADD 120 TO INT
193	1E2B	A5 09		LDA M1	
194	1E2D	69 00		ADC =0	
195	1E2F	10 0B		BPL CONTIN	IF RESULT POSITIVE CONTINUE
196	1E31	A9 00		LDA =0	INT<-120 SET RESULT TO ZERO AND RETURN
197	1E33	A2 03		LDX =3	4 BYTE MOVE
198	1E35	95 08	ZERO	STA X1,X	SET EXP/MANT1 TO ZERO
199	1E37	CA		DEX	
200	1E38	10 FB		BPL ZERO	
201	1E3A	E0		RTS	RETURN
202			*		
203	1E3B	00	OVFLW	BRK	OVERFLOW
204			*		
205	1E3C	20 2C 1F	CONTIN	JSR FLOAT	FLOAT INT
206	1E3F	A2 03		LDX =3	
207	1E41	B5 10	ENTD	LDA Z,X	
208	1E43	95 04		STA X2,X	LOAD EXP/MANT2 WITH Z
209	1E45	CA		DEX	
210	1E46	10 F9		BPL ENTD	
211	1E48	20 4A 1F		JSR FSUB	Z=Z-FLOAT(INT)
212	1E4B	A2 03		LDX =3	4 BYTE MOVE
213	1E4D	B5 08	ZSAV	LDA X1,X	
214	1E4F	95 10		STA Z,X	SAVE EXP/MANT1 IN Z
215	1E51	95 04		STA X2,X	COPY EXP/MANT1 TO EXP/MANT2
216	1E53	CA		DEX	
217	1E54	10 F7		BPL ZSAV	
218	1E56	20 77 1F		JSR FMUL	Z*Z
219	1E59	A2 03		LDX =3	4 BYTE MOVE
220	1E5B	BD DC 1E	LA2	LDA A2,X	
221	1E5E	95 04		STA X2,X	LOAD EXP/MANT2 WITH A2
222	1E60	B5 08		LDA X1,X	
223	1E62	95 18		STA SEXP,X	SAVE EXP/MANT1 AS SEXP
224	1E64	CA		DEX	
225	1E65	10 F4		BPL LA2	
226	1E67	20 50 1F		JSR FADD	Z*Z+A2
227	1E6A	A2 03		LDX =3	4 BYTE MOVE
228	1E6C	BD E0 1E	LB2	LDA B2,X	
229	1E6F	95 04		STA X2,X	LOAD EXP/MANT2 WITH B2
230	1E71	CA		DEX	
231	1E72	10 F8		BPL LB2	
232	1E74	20 9D 1F		JSR FDIV	T=B2/(Z*Z+A2)
233	1E77	A2 03		LDX =3	4 BYTE MOVE
234	1E79	B5 08	DLOAD	LDA X1,X	
235	1E7B	95 14		STA T,X	SAVE EXP/MANT1 AS T
236	1E7D	BD E4 1E		LDA C2,X	
237	1E80	95 08		STA X1,X	LOAD EXP/MANT1 WITH C2


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238 1E82 B5 18      LDA SEXP,X
239 1E84 95 04      STA X2,X      LOAD EXP/MANT2 WITH SEXP
240 1E86 CA        DEX
241 1E87 10 F0      BPL DLOAD
242 1E89 20 77 1F    JSR FMUL      Z*Z*C2
243 1E8C 20 1C 1F    JSR SWAP      MOVE EXP/MANT1 TO EXP/MANT2
244 1E8F A2 03      LDX =3      4 BYTE TRANSFER
245 1E91 B5 14      LTMP LDA T,X
246 1E93 95 08      STA X1,X      LOAD EXP/MANT1 WITH T
247 1E95 CA        DEX
248 1E96 10 F9      BPL LTMP
249 1E98 20 4A 1F    JSR FSUB      C2*Z*Z-B2/(Z*Z+A2)
250 1E9B A2 03      LDX =3      4 BYTE TRANSFER
251 1E9D BD E8 1E    LDD  LDA D,X
252 1EA0 95 04      STA X2,X      LOAD EXP/MANT2 WITH D
253 1EA2 CA        DEX
254 1EA3 10 F8      BPL LDD
255 1EA5 20 50 1F    JSR FADD      D+C2*Z*Z-B2/(Z*Z+A2)
256 1EA8 20 1C 1F    JSR SWAP      MOVE EXP/MANT1 TO EXP/MANT2
257 1EAB A2 03      LDX =3      4 BYTE TRANSFER
258 1EAD B5 10      LFA  LDA Z,X
259 1EAF 95 08      STA X1,X      LOAD EXP/MANT1 WITH Z
260 1EB1 CA        DEX
261 1EB2 10 F9      BPL LFA
262 1EB4 20 4A 1F    JSR FSUB      -Z+D+C2*Z*Z-B2/(Z*Z+A2)
263 1EB7 A2 03      LDX =3      4 BYTE TRANSFER
264 1EB9 B5 10      LF3  LDA Z,X
265 1EBB 95 04      STA X2,X      LOAD EXP/MANT2 WITH Z
266 1EBD CA        DEX
267 1EBE 10 F9      BPL LF3
268 1EC0 20 9D 1F    JSR FDIV      Z/(*** )
269 1EC3 A2 03      LDX =3      4 BYTE TRANSFER
270 1EC5 BD E8 1D    LD12 LDA MHLF,X
271 1EC8 95 04      STA X2,X      LOAD EXP/MANT2 WITH .5
272 1ECA CA        DEX
273 1ECB 10 F8      BPL LD12
274 1ECD 20 50 1F    JSR FADD      +Z/(***)+.5
275 1ED0 38          SEC          ADD INT TO EXPONENT WITH CARRY SET
276 1ED1 A5 1C      LDA INT      TO MULTIPLY BY
277 1ED3 65 08      ADC X1      2***(INT+1)
278 1ED5 85 08      STA X1      RETURN RESULT TO EXPONENT
279 1ED7 60          RTS          RETURN ANS=(.5+Z/(-Z+D+C2*Z*Z-B2/(Z*Z+A2)))*2***(INT+1)
280 1ED8 80 5C      L2E  DCM 1.4426950409 LOG BASE 2 OF E
281 1EDC 86 57      A2  DCM 87.417497202
282 1EE0 6A E1      B2  DCM 617.9722695
283 1EE4 3F 1D      C2  DCM .03465735903
284 1EE8 FA 70      D   DCM 9.9545957821
285 1EE8 83 4F      D
286 A3 03
285 *
286 *
287 *
288 *
289 1F00          ORG $1F00      START OF BASIC FLOATING POINT ROUTINES
290 1F00 18      ADD  CLC          CLEAR CARRY
291 1F01 A2 02      LDX =#02      INDEX FOR 3-BYTE ADD
292 1F03 B5 09      ADD1 LDA M1,X
293 1F05 75 05      ADC M2,X      ADD A BYTE OF MANT2 TO MANT1
294 1F07 95 09      STA M1,X
295 1F09 CA        DEX          ADVANCE INDEX TO NEXT MORE SIGNIF. BYTE

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296 1F0A 10 F7          BPL ADD1      LOOP UNTIL DONE
297 1F0C 60             RTS           RETURN
298 1F0D 06 03          MD1 ASL SIGN   CLEAR LSB OF SIGN
299 1F0F 20 12 1F       JSR ABSWAP    ABS VAL OF MANT1. THEN SWAP MANT2
300 1F12 24 09          ABSWAP BIT M1 MANT1 NEG?
301 1F14 10 05          BPL ABSWP1    NO.SWAP WITH MANT2 AND RETURN
302 1F16 20 0F 1F       JSR FCOMPL    YES. COMPLIMENT IT.
303 1F19 E6 03          INC SIGN      INCR SIGN. COMPLEMENTING LSB
304 1F1B 38             ABSWP1 SEC     SET CARRY FOR RETURN TO MUL/DIV
305                      *
306                      *      SWAP EXP/MANT1 WITH EXP/MANT2
307                      *

308 1F1C A2 04          SWAP LDX =$04   INDEX FOR 4-BYTE SWAP
309 1F1E 94 0B          SWAP1 STY E-1,X
310 1F20 B5 07          LDA X1-1,X     SWAP A BYTE OF EXP/MANT1 WITH
311 1F22 B4 03          LDY X2-1,X     EXP/MANT2 AND LEAVEA COPY OF
312 1F24 94 07          STY X1-1,X     MANT1 IN E(3BYTES). E+3 USED.
313 1F26 95 03          STA X2-1,X
314 1F28 CA            DEX             ADVANCE INDEX TO NEXT BYTE
315 1F29 D0 F3          BNE SWAP1      LOOP UNTIL DONE.
316 1F2B 60             RTS
317                      *
318                      *
319                      *
320                      *      CONVERT 16 BIT INTEGER IN M1(HIGH) AND M1+1(LOW) TO F.P.
321                      *      RESULT IN EXP/MANT1. EXP/MANT2 UNEFFECTED
322                      *
323                      *
324 1F2C A9 0E          FLOAT LDA =$8E
325 1F2E 85 0B          STA X1          SET EXPN TO 14 DEC
326 1F30 A9 00          LDA =0         CLEAR LOW ORDER BYTE
327 1F32 85 0B          STA M1+2
328 1F34 F0 0B          BEQ NORM        NORMALIZE RESULT
329 1F36 C6 0B          NORM1 DEC X1    DECREMENT EXP1
330 1F38 06 0B          ASL M1+2
331 1F3A 26 0A          ROL M1+1       SHIFT MANT1 (3 BYTES) LEFT
332 1F3C 26 09          ROL M1
333 1F3E A5 09          NORM LDA M1     HIGH ORDER MANT1 BYTE
334 1F40 0A            ASL A           UPPER TWO BITS UNEQUAL?
335 1F41 45 09          EOR M1
336 1F43 30 04          BMI RTS1        YES.RETURN WITH MANT1 NORMALIZED
337 1F45 A5 0B          LDA X1         EXP1 ZERO?
338 1F47 D0 ED          BNE NORM1      NO. CONTINUE NORMALIZING
339 1F49 60             RTS1 RTS       RETURN
340                      *
341                      *
342                      *      EXP/MANT2-EXP/MAN1 RESULT IN EXP/MANT1
343                      *
344 1F4A 20 0F 1F       FSUB JSR FCOMPL  COMPL MANT1 CLEARS CARRY UNLESS ZERO
345 1F4D 20 5D 1F       SWPALG JSR ALGNSW RIGHT SHIFT MANT1 OR SWAP WITH MANT2 ON CARRY
346                      *
347                      *      ADD EXP/MANT1 AND EXP/MANT2 RESULT IN EXP/MANT1
348                      *
349 1F50 A5 04          FADD LDA X2
350 1F52 C5 0B          CMP X1         COMPARE EXP1 WITH EXP2
351 1F54 D0 F7          BNE SWPALG     IF UNEQUAL. SWAP ADDENDS OR ALIGN MANTISSAS
352 1F56 20 00 1F       JSR ADD        ADD ALIGNED MANTISSAS
353 1F59 50 E3          ADDEND BVC NORM NO OVERFLOW. NOMALIZE RESULTS
354 1F5B 70 05          BVS RTLOG      OV: SHIFT MANT1 RIGHT. NOTE CARRY IS CORRECT SIGN
355 1F5D 90 BD          ALGNSW BCC SWAP SWAP IF CARRY CLEAR. ELSE SHIFT RIGHT ARITH.
356 1F5F A5 09          RTAR LDA M1     SIGN OF MANT1 INTO CARRY FOR
357 1F61 0A            ASL A           RIGHT ARITH SHIFT
358 1F62 E6 0B          RTLOG INC X1    INCR EXP1 TO COMPENSATE FOR RT SHIFT

```



```

359 1F64 F0 7E      BEQ OVFL      EXP1 OUT OF RANGE
360 1F66 A2 FA      R7 LOG1 LDX =#FA      INDEX FOR 6 BYTE RIGHT SHIFT
361 1F68 A9 A0      ROR1      LDA =#80
362 1F6A B0 01      BCS ROR2
363 1F6C 0A          ASL A
364 1F6D 56 0F      ROR2      LSR E+3,X      SIMULATE ROR E+3,X
365 1F6F 15 0F      ORA E+3,X
366 1F71 95 0F      STA E+3,X
367 1F73 E8          INX          NEXT BYTE OF SHIFT
368 1F74 D0 F2      BNE ROR1      LOOP UNTIL DONE
369 1F76 60          RTS          RETURN
370
371 *
372 *
373 *      EXP/MANT1 X EXP/MANT2 RESULT IN EXP/MANT1
374 1F77 20 0D 1F    FMUL      JSR MD1      ABS. VAL OF THE MANT1, MANT2
375 1F7A 65 08          ADC X1      ADD EXP1 TO EXP2 FOR PRODUCT EXPONENT
376 1F7C 20 CD 1F    JSR MD2      CHECK PRODUCT EXP AND PREPARE FOR MUL
377 1F7F 18          CLC          CLEAR CARRY
378 1F80 20 66 1F    MUL1      JSR RTLOG1    MANT1 AND E RIGHT.(PRODUCT AND MPLIER)
379 1F83 90 03      BCC MUL2      IF CARRY CLEAR, SKIP PARTIAL PRODUCT
380 1F85 20 00 1F    JSR ADD      ADD MULTIPLICAN TO PRODUCT
381 1F88 88          MUL2      DEY          NEXT MUL ITERATION
382 1F89 10 F5      BPL MUL1      LOOP UNTIL DONE
383 1F8B 46 03      MDEND      LSR SIGN      TEST SIGN (EVEN/ODD)
384 1F8D 90 AF      NORMX      BCC NORM      IF EXEN, NORMALIZE PRODUCT, ELSE COMPLEMENT
385 1F8F 38          FCOMPL      SEC          SET CARRY FOR SUBTRACT
386 1F90 A2 03      LDX =#03      INDEX FOR 3-BYTE SUBTRACTION
387 1F92 A9 00      COMPL1      LDA =#00      CLEAR A
388 1F94 F5 08      SBC X1,X      SUBTRACT BYTE OF EXP1
389 1F96 95 08      STA X1,X      RESTORE IT
390 1F98 CA          DEX          NEXT MORE SIGNFICANT BYTE
391 1F99 D0 F7      BNE COMPL1    LOOP UNTIL DONE
392 1F9B F0 BC      BEQ ADDEND      NORMALIZE (OR SHIFT RIGHT IF OVERFLOW)
393 *
394 *
395 *      EXP/MANT2 / EXP/MANT1 RESULT IN EXP/MANT1
396 *
397 1F9D 20 0D 1F    FDIV      JSR MD1      TAKE ABS VAL OF MANT1, MANT2
398 1FA0 E5 08      SBC X1      SUBTRACT EXP1 FROM EXP2
399 1FA2 20 CD 1F    JSR MD2      SAVE AS QUOTIENT EXP
400 1FA5 38          DIV1      SEC          SET CARRY FOR SUBTRACT
401 1FA6 A2 02      LDX =#02      INDEX FOR 3-BYTE INSTRUCTION
402 1FA8 B5 05      DIV2      LDA M2,X
403 1FAA F5 0C      SBC E,X      SUBTRACT A BYTE OF E FROM MANT2
404 1FAC 48          PHA          SAVE ON STACK
405 1FAD CA          DEX          NEXT MORE SIGNIF BYTE
406 1FAE 10 F8      BPL DIV2      LOOP UNTIL DONE
407 1FB0 A2 FD      LDX =#FD      INDEX FOR 3-BYTE CONDITIONAL MOVE
408 1FB2 68          DIV3      PLA          PULL A BYTE OF DIFFERENCE OFF STACK
409 1FB3 90 02      BCC DIV4      IF MANT2<E THEN DONT RESTORE MANT2
410 1FB5 95 08      STA M2+3,X
411 1FB7 E8          DIV4      INX          NEXT LESS SIGNIF BYTE
412 1FB8 D0 F8      BNE DIV3      LOOP UNTIL DONE
413 1FBA 26 08      ROL M1+2
414 1FBC 26 0A      ROL M1+1      ROLL QUOTIENT LEFT, CARRY INTO LSB
415 1FBE 26 09      ROL M1
416 1FC0 06 07      ASL M2+2
417 1FC2 26 06      ROL M2+1      SHIFT DIVIDEND LEFT
418 1FC4 26 05      ROL M2
419 1FC6 B0 1C      BCS OVFL      OVERFLOW IS DUE TO UNNORMALIZED DIVISOR
420 1FC8 88          DEY          NEXT DIVIDE ITERATION

```


421	1FC9	D0 DA		BNE DIV1	LOOP UNTIL DONE 23 ITERATIONS
422	1FCB	F0 BE		BEQ MDEND	NORMALIZE QUOTIENT AND CORRECT SIGN
423	1FCD	86 0B	MD2	STX M1+2	
424	1FCF	86 0A		STX M1+1	CLR MANT1 (3 BYTES) FOR MUL/DIV
425	1FD1	86 09		STX M1	
426	1FD3	B0 0D		BCS OVCHK	IF EXP CALC SET CARRY, CHECK FOR OVFL
427	1FD5	30 04		BMI MD3	IF NEG NO UNDERFLOW
428	1FD7	68		PLA	POP ONE
429	1FD8	68		PLA	RETURN LEVEL
430	1FD9	90 B2		BCC NORMK	CLEAR X1 AND RETURN
431	1FDB	49 80	MD3	EOR =#80	COMPLIMENT SIGN BIT OF EXP
432	1FDD	85 08		STA X1	STORE IT
433	1FDF	A0 17		LDY =#17	COUNT FOR 24 MUL OR 23 DIV ITERATIONS
434	1FE1	60		RTS	RETURN
435	1FE2	10 F7	OVCHK	BPL MD3	IF POS EXP THEN NO OVERFLOW
436	1FE4	00	OVFL	BRK	
437			*		
438			*		
439			*	CONVERT EXP/MANT1 TO INTEGER IN M1 (HIGH) AND M1+1 (LOW)	
440			*	EXP/MANT2 UNEFFECTED	
441			*		
442	1FE5	20 5F 1F		JSR RTAR	SHIFT MANT1 RT AND INCREMENT EXPNT
443	1FE8	A5 08	FIX	LDA X1	CHECK EXPONENT
444	1FEA	C9 8E		CMP =#8E	IS EXPONENT 14?
445	1FEC	D0 F7		BNE FIX-3	NO SHIFT
446	1FEE	60	RTRN	RTS	RETURN
447				END	

END PASS 2

0 ERRORS

OBJECT CODE DUMP

```

;090003FAFA000000EA000000002CA
;01001C000001D
;181D00A509F002100100201C1FA200A504A08084044980850A1001069D
;181D18CA8609202C1FA203B5049510B5089518BDD41D9508CA10F00993
;181D30204A1FA203B5089514B5109508BDD41D9504CA10F020501F08FB
;1A1D48A203B5149504CA10F9209D1FA203B50895149504CA10F720771F0A60
;181D62201C1FA203BDE41D9508CA10F8204A1FA203BDE01D9504CA0A0F
;181D7A10F8209D1FA203BDDC1D9504CA10F820501FA203B514950409EF
;191D92CA10F920771FA203BDF81D9504CA10F820501FA203B51895040ABD
;191DABCA10F920501FA203BDD81D9504CA10F820771F6020001DA20309FD
;181DC4BDD01D9504CA10F820771F607F6F2DED805A827A7F58B90C0B9D
;101DDC8052B04081AB8649806A08667F40000006DD
;191E00A203BDD81E9504CA10F820771FA203B5089510CA10F920E81F0AB1
;181E19A50A851C38E97CA509E900101518A50A6978A5096900100B07D2
;1A1E31A900A2039508CA10FB6000202C1FA203B5109504CA10F9204A1F0953
;191E4BA203B50895109504CA10F720771FA203BDDC1E9504B50895180A08
;191E64CA10F420501FA203BDE01E9504CA10F8209D1FA203B50895140AAA
;181E7DBDE41F9508B5189504CA10F020771F201C1FA203B5149508095B
;181E95CA10F9204A1FA203BDE81E9504CA10F820501F201C1FA2030989
;181EADB5109508CA10F9204A1FA203B5109504CA10F9209D1FA20309F8
;191EC5BDE81D9504CA10F820501F38A51C6508850860805C551F86570A37
;0E1FDF6AF1894D3F1D7B46FA70834FA303072A
;191F0018A202B50975059509CA10F760060320121F24091005208F1F0665
;191F19F60338A204940BB507B40394079503CAD0F360A98F8508A9000AB7
;181F32850BF008C608060B260A2609A5090A45093004A508D0ED600733
;181F4A208F1F205D1FA504C508D0F720001F50E3700590BDA5090A0914
;181F62E608F07EA2FAA980B0010A560F150F950FEXD0F260200D1F0AF8
;181F7A650820CD1F1820661F900320001F8810F5460390AF38A20307AB
;181F92A900F5089508CAD0F7F0BC200D1FF50820CD1F38A202B5050B24
;181FAAF50C48CA10F8A2FD6890029508E8D0F8260B260A260906070A7F
;191FC226062605B01C88D0DAF0BE860B860A8609B00D3004686890B20AB0
;141FDB49808508A0176010F700205F1FA508C98ED0F760094B
;00

```

END

HIGH SPEED DOUBLE PRECISION MULTIPLICATION (HISPDMP)

By permission and courtesy of
Motorola's M6800 User Group Library

FUNCTION: The following 6800 Microcomputer routine multiplies two 16 bit unsigned binary numbers resulting in a 32 bit product. This routine takes advantage of direct mode of addressing. The HISPDMP routine requires 28 bytes of program storage.

PARAMETERS: Both operands must be in memory within the address range of 0 thru 255.

RESULTS: The 32 bit product is retained in registers "A" (most significant byte), and "B" (second most significant byte), and the least two significant bytes in memory locations initially occupied by the multiplier (QH and QL).

ASSEMBLER/COMPILER: M6800 cross assembler
EXORciser resident assembler

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DEPOSITORY PROGRAM INDEX FOR COPIES
OF THIS PROGRAM

```

00001          NAM      HISPDMP
00002          * DOUBLE PRECISION UNSIGNED BINARY
00003          * MULTIPLICATION
00004          * (PH,PL) * (QH,QL) --INTO-- (A,B,QH,QL)
00005          * * * * *
00006          * * * * * *****ANYWHERE IN READ/WRITE
00007          * * * * * MEMORY
00008          * * * * *
00009          * *****IN MEMORY WITHIN
00010          * ADDRESS RANGE 0 TO 255.
00011          *
00012          * NOT REENTRANT CODE
00013          *
00014          * SOURCE INSTRUCTIONS: 14
00015          * PROGRAM: 28 BYTES
00016          * DATA AND SCRATCH: 4 BYTES
00017          * RUNNING TIME:
00018          * MINIMUM: 467 CYCLES
00019          * MAXIMUM: 563 CYCLES
00020          *
00021          * BOTH OPERANDS INITIALLY IN MEMORY
00022          * WITHIN ADDRESS RANGE 0 THRU 255.
00023          *
00024          * PRODUCT RETAINED IN REGISTERS
00025          * "A" (MOST SIGNIFICANT BYTE) AND
00026          * "B" (2ND MOST SIGNIFICANT BYTE)
00027          * AND IN MEMORY LOCATIONS INITIALLY
00028          * OCCUPIED BY THE MULTIPLIER (QH AND QL).

```



```

00029          *
00030 0000          ORG      0
00031 0000 0001    PH      RMB      1
00032 0001 0001    PL      RMB      1
00033 0002 0001    OH      RMB      1
00034 0003 0001    OL      RMB      1
00036 0100          ORG     $100
00038 0100 CE 0010    LDX     #16
00039 0103 4F          CLR     A
00040 0104 5F          CLR     B
00041 0105 76 0002    ROR     OH
00042 0108 76 0003    ROR     OL
00043 010B 24 04    NXT     BCC     ROTAT
00044 010D DB 01      ADD     B     PL
00045 010F 99 00      ADC     A     PH
00046 0111 46          ROTAT  ROR     A
00047 0112 56          ROR     B
00048 0113 76 0002    ROR     OH
00049 0116 76 0003    ROR     OL
00050 0119 09          DEX
00051 031A 26 FF      BNE     NXT
00052          END

```

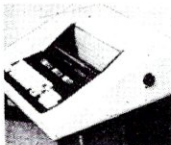
TOTAL ERRORS 00000

!

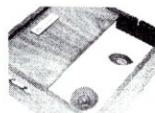
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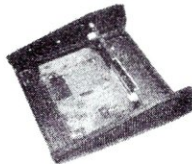
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REENTRANT 16 BIT DIVIDE SUBROUTINE (DIV16)

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of Motorola's M6800 User Group Library

FUNCTION: The following 6800 Microcomputer routine divides two 16 bit unsigned numbers giving a 16 bit result. It is a reentrant subroutine and therefore can be interrupted during execution, entered by another user, and subsequently reentered at the point of interruption by the first user without losing any of the intermediate results. To enter routine, call: JSR DIV16. The DIV16 routine requires 69 bytes of program storage.

PARAMETERS: Enter with:

A (High order byte of dividend)
B (Low order byte of dividend)
X (Address of high order byte of divisor)

RESULTS: The 16 bit result is retained in the:

A (High order byte of result)
B (Low order byte of result)
X Will be unchanged

ASSEMBLER/COMPILER: M6800 Cross assembler
EXORciser Resident Assembler

```

00001          NAM      DIV16
00002          * REVISION 1
00003          * 16 BIT UNSIGNED DIVIDE (16 BIT RESULT)
00004          * A,B DIVIDGD BY (X),(X+1)
00005          * RESULT IN A,B (X),(X+1) UNCHANGED
00006 0000 37      DIV16 PSH B          DIVIDEND TO STACK
00007 0001 36          PSH A
00008 0002 A6 00      LDA A  X
00009 0004 E6 01      LDA B  1,X
00010 0006 37          PSH B          DIVISOR TO STACK
00011 0007 36          PSH A
00012 0008 34          DES          LEAVE ROOM FOR COUNT
00013 0009 30          TSX          (X) POINTER TO STACKED DATA
00014 000A 86 01      LDA A  #1
00015 000C 6D 01      TST  1,X
00016 000E 2B 0B      BMI  DIV153
00017 0010 4C          DIV151 INC A
00018 0011 68 02          ASL  2,X
00019 0013 69 01          ROL  1,X
00020 0015 2B 04      BMI  DIV153
00021 0017 81 11      CMP A  #17
00022 0019 26 F5      BNE  DIV151
00023 001B A7 00      DIV153 STA A  0,X          SAVE COUNT
00024 001D A6 03          LDA A  3,X
00025 001F E6 04          LDA B  4,X
00026 0021 6F 03          CLR  3,X
00027 0023 6F 04          CLR  4,X
00028          * STACK LOOKS LIKE
00029          * +0 COUNT
00030          * +1 MS BYTE OF DIVISOR
00031          * +2 LS BYTE

```



```

00032      * +3 MS BYTE OF DIVIDEND
00033      * +4 LS BYTE
00034      * +5 MS BYTE RETURN ADDRESS
00035      * +6 LS BYTE
00036 0025 E0 02  DIV163 SUB B   2,X
00037 0027 A2 01      SBC A    1,X
00038 0029 24 07      BCC      DIV165  DIVISOR STILL OK
00039 002B EB 02      ADD B    2,X  DIVISOR TOO LARGE
00040 002D A9 01      ADC A    1,X  RESTORE
00041 002F 0C      CLC
00042 0030 20 01      BRA      DIV167
00043 0032 0D      DIV165 SEC
00044 0033 69 04  DIV167 ROL    4,X
00045 0035 69 03      ROL    3,X
00046 0037 64 01      LSR    1,X  ADJUST DIVISOR
00047 0039 66 02      ROR    2,X
00048 003B 6A 00      DEC    0,X
00049 003D 26 E6      BNE      DIV163
00050      * CLEAN UP STACK
00051 003F 31      INS
00052 0040 31      INS
00053 0041 31      INS
00054 0042 32      PUL A
00055 0043 33      PUL B
00056 0044 39      RTS
00057      END

```

TOTAL ERRORS 00000

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REENTRANT DOUBLE PRECISION MULTIPLICATION (RENTMUP)

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FUNCTION: The following 6800 Microcomputer routine is a reentrant routine that multiplies two 16 bit unsigned binary numbers to produce a 32 bit product. The RENTMUP routine requires 27 bytes of program storage and 5 bytes of RAM scratch pad memory.

PARAMETERS: This reentrant version assumes that the data has been placed in a stack as indicated below.

RESULTS: The product, comprising four bytes, is saved in registers:

"A" (Most significant byte)

"B" (Second most significant byte)

and the least two significant bytes are in the stack at locations indicated by QH and QL.

ASSEMBLER/COMPILER: M6800 Cross assembler
EXORciser resident assembler

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X1 — BLANK (For P Counter if used as subroutine)
BLANK (For P Counter if used as subroutine)
BLANK (For Bit Counter)
QH (MSB of Multiplier)
QL (LSB of Multiplier)
PH (MSB of Multiplicand)
PL (LSB of Multiplicand)

```

00001          NAM      RENTMUP
00002          * DOUBLE PRECISION UNSIGNED BINARY
00003          * MULTIPLICATION
00004          * (PH,PL) * (QH,QL) --INTO-- (A,B,QH,QL)
00005          *
00006          * REENTRANT CODE
00007          *
00008          * SOURCE INSTRUCTIONS: 16
00009          * PROGRAM: 27 BYTES
00010          * DATA AND SCRATCH: 5 BYTES
00011          * RUNNING TIME:
00012          * MINIMUM: 558 CYCLES
00013          * MAXIMUM: 718 CYCLES
00014          *
00015          * BOTH OPEERANDS INITIALLY IN STACK
00016          * AND OBTAINED BY INDEXED ADDRESSING
00017          *
00018          * PRODUCT RETAINED IN REGISTERS
00019          * "A" (MOST SIGNIFICANT BYTE) AND
00020          * "B" (2ND MOST SIGNIFICANT BYTE)
00021          * AND IN THE STACK (LEAST
00022          * SIGNIFICANT TWO BYTES),

```



```

00023      *
00024      * THIS REENTRANT CODED VERSION ASSUMES
00025      * THAT DATA HAS BEEN PLACED IN A STACK
00026      * AS INDICATED BELOW:
00027      *
00028      * SP ---
00029      * X1 --- BLANK (NOT USED)
00030      *          BLANK (NOT USED)
00031      *          BLANK (FOR BITS TO GO)
00032      *          QH (MSB OF MULTIPLIER)
00033      *          QL (LSB OF MULTIPLIER)
00034      *          PH (MSB OF MULTIPLICAND)
00035      *          PL (LSB OF MULTIPLICAND)
00036      *
00037      * THE TOP TWO BYTES OF THE STACK ARE
00038      * NOT USED BY THIS PROGRAM. THEY ARE
00039      * INTENDED FOR A RETURN ADDRESS IF THE
00040      * PROGRAM IS TO BE USED AS A
00041      * SUBROUTINE. IN THE LATTER CASE THE
00042      * FOLLOWING STATEMENT SHOULD BE ADDED
00043      * AT THE END OF THE PROGRAM:
00044      *     RTS
00045      *
00046      * THE PROGRAM USES OP-CODE TSX TO ENTER
00047      * AN ADDRESS X1 INTO THE INDEX REGISTER,
00048      * AS INDICATED ABOVE.
00049      *
00050      * THE PRODUCT, COMPRISING FOUR BYTES,
00051      * IS SAVED IN REGISTERS "A" AND "B" AND
00052      * IN THE STACK AT LOCATIONS INDICATED
00053      * ABOVE BY "QH" AND "QL".
00054      *
00055      *     ORG     0

```

```

00057 0000 30      TSX
00058 0001 86 10    LDA A  #16
00059 0003 A7 02    STA A  2,X
00060 0005 4F      CLR A
00061 0006 5F      CLR B
00062 0007 66 03    ROR     3,X
00063 0009 66 04    ROR     4,X
00064 000B 24 04    NNEXT  BCC  RROTN
00065 000D EB 06    ADD B  6,X
00066 000F A9 05    ADC A  5,X
00067 0011 46      RROTN  ROR A
00068 0012 56      ROR B
00069 0013 66 03    ROR     3,X
00070 0015 66 04    ROR     4,X
00071 0017 6A 02    DEC     2,X
00072 0019 26 F0    BNE     NNEXT
00073      END

```

TOTAL ERRORS 00000

EXPANDED BLACKJACK IN BASIC

by Ed Keith

Blackjack has always been one of my favorite card games. It allows for strategies based on information from the dealer's up card and is not simply a dumb-luck game. After surveying the available versions that I had seen in print, I found none were truly complete. One version reshuffled whenever it ran out of cards regardless of any cards already dealt. Another allowed doubling down (doubling your initial bet and receiving only one more card), but not splitting pairs. This version not only allows both splitting pairs and doubling down but also gives you the option of from one to four decks.

The cards are kept in a table labeled "D" for deck. The cards are represented by sequential numbers from 1 to 52. The ace of spades is represented by the value 1, the deuce 2, the king 13. The ace of hearts is stored as 14 and so on up to the king of clubs at 52. Whenever multiple decks are used the 1 to 52 sequence is repeated up to four times. Once the number of a card is obtained the routine at 2370 will give you its value.

The cards are shuffled by the routine at 1920. It generates an index that runs from the lowest card to be shuffled (initially 1) to the top (52, 104, 156 or 208). With each index the program generates a random number not higher than the number of cards in the deck nor lower than the lowest card to be shuffled. The cards indicated by the random number and the index are exchanged, disordering the deck. If a shuffle is required during play, after cards have been dealt, the routine at 2920 will exchange the N cards dealt with the first N cards in the deck and sort from N+1 to the top. This ensures that no cards will collect at the top of the deck and never get sorted.

At the start of the game you may obtain instructions if you wish. I have kept most of the messages under 33 characters so that they will work on most TV typewriter terminals. If your terminal supports screen clear or home up, I recommend that you omit line 3840 and change line 0180 to GOSUB 3850. Then when you enter line 3850 follow the opening quotes with the control characters to home up and clear the screen before the text. A PAUSE might be added at line 3910 to allow you to study the rules. Then begin the literal at 3920 with a home up and screen clear as before. For clarity of play, I also suggest that you precede the DEALING message with a home up.

When you have selected the number of decks that you desire (from 1 to 4) the program will expect a bet, then proceed to show you its up card and your two

cards, then request a play.

The play command codes to enter are:

0 - STAND (You're happy with your total).

1 - DRAW (Your total is low).

2 - DOUBLE DOWN (You wish to double your bet and get only 1 more card. This is only legal on the first 2 cards of any one of your hands).

3 - SPLIT A PAIR (Any pair can be split, even pairs after the first; the program has room for up to 16 hands. When you split aces you will only receive one card on each and a 21 under those conditions only pays 1-to-1, not the usual 1½-to-1 as in a natural blackjack).

If you need some help with the strategy involved, you might read Scarne's book on "Gaming" or "Beat the Dealer" by Thorp. Perhaps you might like to try your own system at home for free rather than at expensive Las Vegas!

The program requires that your machine have a random number function. The random functions usually come in two formats. A number from 0.0 to 1.0 in the case of a BASIC with floating-point numbers, or between 0 and 32767 as is the case in some integer only BASICs such as SWTPC's MICROBASIC. To modify the program for the integer only BASICs, change the shuffle routine like this:

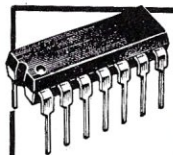
```
1940 LET C = RND
```

```
1945 LET C = C-C/E*E
```

At first glance this may appear to do nothing but remember two things. In an integer machine, C divided by E will not have a remainder and the division will be done before the multiplication (i.e. if $C = 2974$ and $E = 52$, $C/E = 57$, $57 * E = 1964$ and $C - 1964 = 10$), the result of the operation is really to get the remainder of C/E (also called the modulus function).

This program is running on a XEROX 560 and also on a Southwest Technical Products (SWTPC) 6800 Computer System. The latter with the integer and screen controls added. On the SWTPC 6800 the program runs in 10K of RAM storage. If your RAM memory is smaller, here are some suggestions that should bring it in under 8K.

1. Omit the instructions.
2. Leave out the remarks.
3. Shorten the messages.
4. As a last resort, enter the code without spaces (i.e. 3601FU = 0GOTO3780), since most BASIC interpreters must store the blanks as well as the instruction.



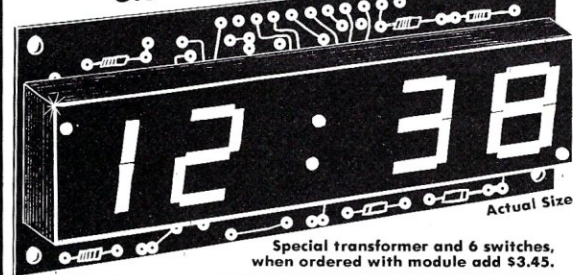
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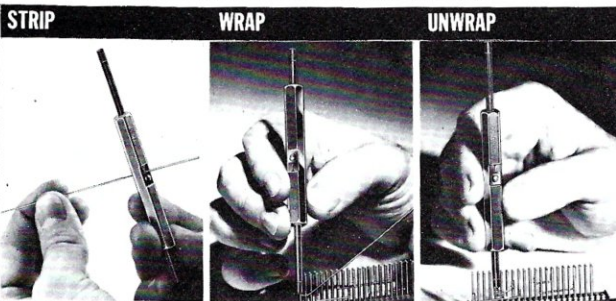
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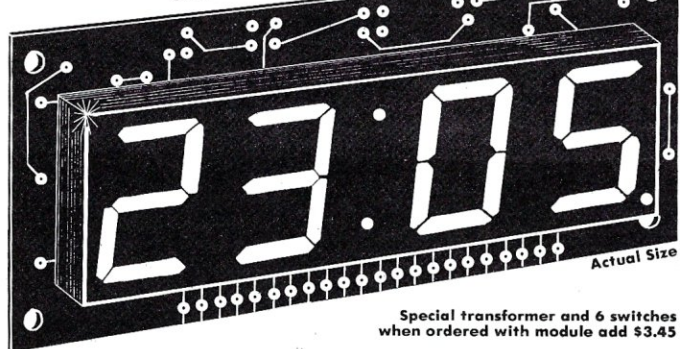


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Along with the source code you will find a table of variables and routines. Should you desire to make modifications these will aid your quest.

The sample run is worth a glance as it shows you what to expect from the program in terms of output. Please keep in mind that it was run with my winnings already at \$2500. After the instructions, I entered a request for four decks and my first bet was \$500 (a big spender!). The dealer's up card was a jack and my total was seven. My play was a 1, I wanted to draw to improve my total. Luckily I got a jack giving me a total of seventeen so I decided to stand (a play command of 0). On this hand the dealer busted bringing my total to \$3000. The next hand is quite complicated and shows all of the options. Again I bet \$500. The dealer shows a seven and I have a pair of kings which I decide to split (play command = 3). The program then prints — PLAY FOR HAND1? I decide to draw another card to the first king and get an eight. My play is stand (0) as a total of eighteen is good. The program then prints the first card already assigned to the second hand when I split the kings and requests a play. I draw *another* king and immediately split this new pair giving me three hands. One already frozen at eighteen and two single kings in the other two. The program requests another play for hand two and I enter a 1 for a draw and receive an ace for a total of twenty-one or eleven. I decide to be brave and enter a play of 2 to double down. Counting the hand as eleven, not twenty-one (not a recommended play under most circumstances) I draw an eight making my total nineteen. So my play for that hand automatically terminates and the program leads me on to hand three. I enter a play command code of 1, a draw, and get a ten for a total of twenty. I stand by entering a 0. My hands total eighteen, nineteen, and twenty. The dealer had a king in the hole giving him a total of seventeen which loses to all three of my hands. The first and third hand have \$500 bet, the second \$1000 since I doubled down, giving me a win of \$2000 and bringing my total to \$5000. Now that I've won that much I can afford a new floppy disk so I enter a bet of 0 to end the game. There's only one problem — from whom do I collect?

I hope you collect some enjoyment from this program and if you have any questions or comments, please drop me a line through the INTERFACE AGE, Letters to the Software Editor section.

By the way, why not write up your favorite game and submit the complete program to INTERFACE AGE for publication?

SEE MICROCOMPUTER SOFTWARE
DEPOSITORY PROGRAM INDEX FOR COPIES
OF THIS PROGRAM

<><> B L A C K J A C K <><> SAMPLE RUN

17:20 OCT 04 BASICBJ...

WELCOME TO THE KEITH CASINO
WE PLAY VEGAS STYLE BLACKJACK!

INSTRUCTIONS (0-NO, 1-YES) ?1

THE DEALER STANDS ON 17 OR MORE,
BUT WILL HIT SOFT 17
YOU MAY SPLIT ANY PAIR.
YOU MAY DOUBLE ON THE 1ST 2 CARDS
AND GET ONLY 1 MORE CARD.

USE THESE CODES TO PLAY:

0 - STAND
1 - HIT
2 - DOUBLE DOWN
3 - SPLIT A PAIR

A ZERO BET ENDS THE GAME
A NEGATIVE BET FORCES A SHUFFLE
GOOD LUCK - LET'S START
HOW MANY DECKS (1-4) ?4
SHUFFLING.. DRINKS ANYONE?

BET PLEASE ?500

DEALING

MY UP CARD	JACK	OF	CLUBS
YOUR 1ST CARD	2	OF	SPADES
YOUR 2ND CARD	5	OF	HEARTS
PLAY	?1		
YOUR CARD IS	JACK	OF	HEARTS
PLAY	?0		
MY HOLE CARD	6	OF	HEARTS
I DRAW THE	7	OF	SPADES
I BUSTED	MY TOTAL IS	23	
YOU WON	THE HAND		

YOU'RE AHEAD \$ 3000

BET PLEASE ?500

DEALING

MY UP CARD	7	OF	SPADES
YOUR 1ST CARD	KING	OF	CLUBS
YOUR 2ND CARD	KING	OF	DIAMONDS
PLAY	?3		
PLAY FOR HAND	1	?1	
YOUR CARD IS	8	OF	DIAMONDS
PLAY FOR HAND	1	?0	
YOUR 1ST CARD FOR HAND	2	2	WAS KING OF DIAMONDS
PLAY FOR HAND	2	?1	
YOUR CARD IS	KING	OF	HEARTS
PLAY FOR HAND	2	?3	
PLAY FOR HAND	2	?1	
YOUR CARD IS	ACE	OF	HEARTS
PLAY FOR HAND	2	?2	
YOU DRAW THE	8	OF	SPADES
YOUR 1ST CARD FOR HAND	3	3	WAS KING OF HEARTS
PLAY FOR HAND	3	?1	
YOUR CARD IS	10	OF	HEARTS
PLAY FOR HAND	3	?0	
MY HOLE CARD	KING	OF	SPADES
MY TOTAL IS	17		
YOU WON HAND	1		
YOU WON HAND	2		
YOU WON HAND	3		

YOU'RE AHEAD \$ 5000

BET PLEASE ?0

THANKS FOR PLAYING
HOPE YOU ENJOYED YOURSELF
HERE'S YOUR FINAL STANDING!
YOU'RE AHEAD \$ 5000

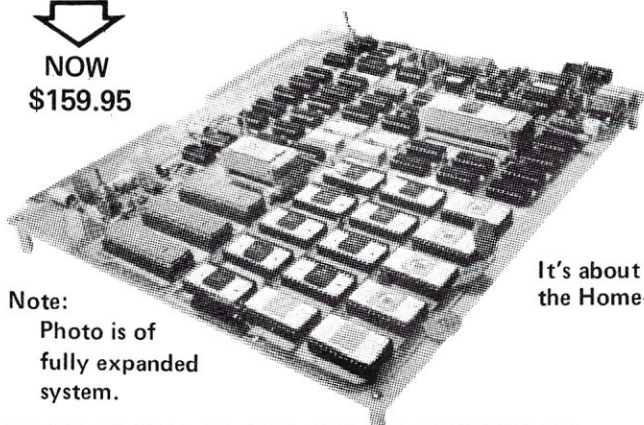
3820 HALT

<><> B L A C K J A C K <><> VARIABLE AND ROUTINE LIST

<><> VARIABLES <><>

A	- POINTER TO THE UNUSED DECK OF CARDS
B	- POINTER TO THE BOTTOM OF THE DECK FOR SHUFFLING
C	- A RANDOM SUBSCRIPT BETWEEN "B" AND "E" FOR SHUFFLING
D(208)	- THE DECK(S) OF CARDS
E	- POINTER TO THE TOP OF THE DECK FOR SHUFFLING
F	- PLAY VARIABLE (0-STAND, 1-HIT, 2-DOUBLE, 3-SPLIT)
G	- THE NUMBER OF THE HAND CURRENTLY IN PLAY
H(16)	- THE AMOUNT BET ON EACH HAND
I THRU N	- SUBSCRIPTS AND COUNTERS
O(16)	- THE NUMBER OF ACES IN EACH OF THE PLAYERS HANDS
P(16,11)	- THE PLAYERS HANDS. 16 HANDS BY 11 CARDS MAX
Q(11)	- THE DEALERS CARDS
R	- THE NUMBER OF HANDS THE PLAYER HAS
S(16)	- THE NUMBER OF CARDS IN EACH OF THE PLAYERS HANDS
T	- THE NUMBER OF CARDS IN THE DEALERS HAND
U	- THE AMOUNT OF THE ORIGINAL BET
V	- TOTAL AMOUNT WON OR LOST
W	- THE TOTAL OF THE DEALERS HAND
X(16)	- THE TOTAL OF EACH OF THE PLAYERS HANDS
Y	- THE NUMBER OF HANDS NOT LOST BY THE PLAYER
Z	- THE NUMBER OF ACES IN THE DEALERS HAND

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Note:

Photo is of
fully expanded
system.

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<<>> ROUTINES <<>>

```

0780 - TEST FOR PLAYER HIT
1030 - TEST FOR END OF THIS HAND
1130 - PLAYER STAND ROUTINE
1230 - DOUBLE DOWN ROUTINE
1500 - PAIR SPLITTING ROUTINE
1600 - ACE SPLITTING 1 CARD LIMIT ROUTINE
1840 - BUILD 1 TO 4 DECKS OF CARDS
1920 - SHUFFLE THE CARDS FROM "B" TO "E"
2030 - INITIAL HAND DEAL OUT ROUTINE
2260 - COMPUTE VALUE OF THE DEALERS HAND
2370 - COMPUTE THE VALUE OF A CARD
2470 - PRINT A CARD
2810 - COMPUTE THE VALUE OF THE PLAYERS HAND
2920 - SAVE THE CARDS ALREAD DEALT AND RESHUFFLE
3060 - THE DEALERS LOGIC ROUTINE
3540 - THE PLAYERS WON/LOST STATUS REPORTING ROUTINE
3650 - THE INSURANCE ROUTINE
3780 - END OF GAME MESSAGES
3840 - PLAYING INSTRUCTIONS

```

SOURCE LISTING OF <<>> B L A C K J A C K <<>> BY ED KEITH

```

0100 DIM D(208),H(16),O(16),P(16,11),Q(11),S(16),X(16)
0110 PRINT
0120 PRINT "WELCOME TO THE KEITH CASINO"
0130 PRINT "WE PLAY VEGAS STYLE BLACKJACK!"
0140 PRINT
0150 PRINT "INSTRUCTIONS (0-NO, 1-YES)";
0160 INPUT M
0170 IF M<>1 GOTO 190
0180 GOSUB 3840
0190 LET R=16
0200 PRINT "HOW MANY DECKS (1-4)";
0210 INPUT N
0220 IF N>0 GOTO 250
0230 PRINT "1 TO 4 DECKS ONLY. REENTER";
0240 GOTO 210
0250 IF N>4 GOTO 230
0260 LET E=N*52
0270 GOSUB 1840
0280 LET B=1
0290 GOSUB 1920
0300 LET A=1
0310 PRINT
0320 LET G=1
0330 PRINT "BET PLEASE";
0340 INPUT U
0350 IF U>0 GOTO 400
0360 IF U=0 GOTO 3780
0370 LET B=1
0380 GOSUB 1920
0390 GOTO 330
0400 IF U<=500 GOTO 430
0410 PRINT "SORRY, THE HOUSE LIMIT IS $500!"
0420 GOTO 330
0430 GOSUB 2030
0440 LET H(1)=U
0450 LET N=Q(2)
0460 PRINT "MY UP CARD";
0470 GOSUB 2470
0480 LET N=P(R,1)
0490 PRINT "YOUR 1ST CARD";
0500 GOSUB 2470
0510 LET N=P(R,2)
0520 PRINT "YOUR 2ND CARD";
0530 GOSUB 2470
0540 GOSUB 2810
0550 IF M<>11 GOTO 570
0560 GOSUB 3650
0570 IF W<>21 GOTO 660
0580 PRINT "I HAVE BLACKJACK, ";
0590 IF X(1)<>21 GOTO 630
0600 PRINT "SO DO YOU, WE PUSH"
0610 GOSUB 3550
0620 GOTO 310
0630 PRINT "YOU LOSE"
0640 LET V=V-U
0650 GOTO 610
0660 IF X(1)<>21 GOTO 700
0670 PRINT "YOU HAVE BLACKJACK, YOU WIN!"
0680 LET V=V+3*U/2
0690 GOTO 610
0700 PRINT "PLAY ";
0710 IF R=1 GOTO 730
0720 PRINT "FOR HAND ";G;" ";
0730 INPUT F
0740 IF F>-1 GOTO 770
0750 PRINT "ONLY 0-4 IS VALID, REENTER"
0760 GOTO 730
0770 IF F>3 GOTO 750
0780 IF F<>1 GOTO 1110
0790 REM - PLAYER HIT ROUTINE *****
0800 IF A<=E GOTO 820
0810 GOSUB 2920
0820 LET M=S(G)
0830 LET M=M+1
0840 LET S(G)=M
0850 LET N=D(A)
0860 LET P(G,M)=N
0870 PRINT "YOUR CARD IS";
0880 GOSUB 2470
0890 GOSUB 2370

```

```

0900 LET A=A+1
0910 IF N<>11 GOTO 930
0920 LET O(G)=O(G)+1
0930 LET X(G)=X(G)+N
0940 IF X(G)<22 GOTO 700
0950 IF O(G)=0 GOTO 990
0960 LET O(G)=O(G)-1
0970 LET X(G)=X(G)-10
0980 GOTO 940
0990 PRINT "YOU BUSTED WITH ";X(G)
1000 LET X(G)=0
1010 LET Y=Y-1
1020 REM - CHECK FOR END OF PLAY *****
1030 IF G<R GOTO 1060
1040 GOSUB 3060
1050 GOTO 310
1060 LET G=G+1
1070 LET N=P(G,1)
1080 PRINT "YOUR 1ST CARD FOR HAND ";G;" WAS";
1090 GOSUB 2470
1100 GOTO 700
1110 IF F<>0 GOTO 1180
1120 REM - PLAYER STAND ROUTINE *****
1130 IF X(G)<22 GOTO 1030
1140 IF O(G)=0 GOTO 990
1150 LET X(G)=X(G)-10
1160 LET O(G)=O(G)-1
1170 LET G=G+1
1180 IF F<>2 GOTO 1400
1190 IF S(G)=2 GOTO 1230
1200 PRINT "DOUBLE ON 1ST 2 CARDS ONLY"
1210 GOTO 700
1220 REM - DOUBLE DOWN ROUTINE *****
1230 IF A<=E GOTO 1250
1240 GOSUB 2920
1250 LET H(G)=2*U
1260 LET N=D(A)
1270 LET P(G,3)=N
1280 LET A=A+1
1290 PRINT "YOU DRAW THE";
1300 GOSUB 2470
1310 GOSUB 2370
1320 IF N<>11 GOTO 1340
1330 LET O(G)=O(G)+1
1340 LET X(G)=X(G)+N
1350 IF X(G)<22 GOTO 1030
1360 IF O(G)=0 GOTO 990
1370 LET O(G)=O(G)-1
1380 LET X(G)=X(G)-10
1390 GOTO 1350
1400 LET N=P(G,1)
1410 LET Y=Y+1
1420 GOSUB 2370
1430 LET M=N
1440 LET N=P(G,2)
1450 GOSUB 2370
1460 IF M=N GOTO 1500
1470 PRINT "YOU MAY ONLY SPLIT PAIRS"
1480 GOTO 700
1490 REM - PAIR SPLIT ROUTINE *****
1500 LET R=R+1
1510 LET Y=Y+1
1520 LET P(R,1)=P(G,2)
1530 LET S(G)=1
1540 LET S(R)=1
1550 LET X(G)=X(G)/2
1560 LET X(R)=X(G)
1570 LET H(R)=U
1580 IF N<>11 GOTO 700
1590 REM - ACES WERE SPLIT - 1 CARD ON EACH *****
1600 IF A<=E GOTO 1620
1610 GOSUB 2920
1620 LET N=D(A)
1630 LET P(G,2)=N
1640 PRINT "1ST ACE GETS A";
1650 GOSUB 2470
1660 GOSUB 2370
1670 IF N<>11 GOTO 1690
1680 N=1
1690 LET X(G)=X(G)+N
1700 LET A=A+1
1710 IF A<=E GOTO 1730
1720 GOSUB 2920
1730 LET N=D(A)
1740 LET P(R,2)=N
1750 PRINT "2ND ACE GETS A";
1760 GOSUB 2470
1770 GOSUB 2370
1780 IF N<>11 GOTO 1800
1790 N=1
1800 LET X(R)=X(R)+N
1810 LET A=A+1
1820 GOTO 1040
1830 REM - BUILD 1 TO 4 DECKS OF CARDS *****
1840 FOR I=1 TO N
1850 LET J=(I-1)*52
1860 FOR K=1 TO 52
1870 LET D(K+J)=K
1880 NEXT K
1890 NEXT I
1900 RETURN
1910 REM - SHUFFLE THE CARDS *****
1920 PRINT "SHUFFLING.. DRINKS ANYONE?"
1930 FOR I=B TO E
1940 LET C=RND(0)*E
1950 IF C<B GOTO 1940

```


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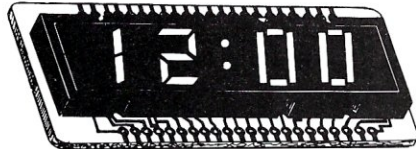
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7406—29c	7447—85c	7490—65c	74165—1.10
7408—19c	7448—85c	7492—75c	74174—95c
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7413—50c	7473—39c	74121—38c	74192—1.25
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```

1960 LET L=D(I)
1970 LET D(I)=D(C)
1980 LET D(C)=L
1990 NEXT I
2000 LET A=B
2010 RETURN
2020 REM - DEAL THE CARDS *****
2030 FOR I=1 TO 11
2040 LET Q(I)=0
2050 FOR J=1 TO R
2060 LET P(J,I)=0
2070 NEXT J
2080 NEXT I
2090 LET R=1
2100 LET Y=1
2110 IF A+4<=E GOTO 2140
2120 LET B=1
2130 GOSUB 1920
2140 PRINT "DEALING"
2150 LET P(R,1)=D(A)
2160 LET Q(1)=D(A+1)
2170 LET P(R,2)=D(A+2)
2180 LET Q(2)=D(A+3)
2190 LET A=A+4
2200 LET T=2
2210 LET S(1)=2
2220 GOSUB 2260
2230 LET M=N
2240 RETURN
2250 REM - COMPUTE THE VALUE OF THE DEALERS HAND ***
2260 LET Z=0
2270 LET W=0
2280 FOR I=1 TO 2
2290 LET N=Q(I)
2300 GOSUB 2370
2310 IF N<>11 GOTO 2330
2320 LET Z=Z+1
2330 LET W=W+N
2340 NEXT I
2350 RETURN
2360 REM - COMPUTE THE VALUE OF A CARD *****
2370 IF N<14 GOTO 2400
2380 LET N=N-13
2390 GOTO 2370
2400 IF N<>1 GOTO 2430
2410 LET N=11
2420 RETURN
2430 IF N<11 GOTO 2450
2440 LET N=10
2450 RETURN
2460 REM - PRINT A CARD *****
2470 LET I=0
2480 IF N<14 GOTO 2520
2490 LET N=N-13
2500 LET I=I+1
2510 GOTO 2480
2520 IF N<>1 GOTO 2550
2530 PRINT TAB(17);"ACE";
2540 GOTO 2680
2550 IF N>9 GOTO 2580
2560 PRINT TAB(18);N;
2570 GOTO 2680
2580 IF N>10 GOTO 2610
2590 PRINT TAB(17);N;
2600 GOTO 2680
2610 IF N>11 GOTO 2640
2620 PRINT TAB(16);"JACK";
2630 GOTO 2680
2640 IF N>12 GOTO 2670
2650 PRINT TAB(15);"QUEEN";
2660 GOTO 2680
2670 PRINT TAB(16);"KING";
2680 PRINT " OF ";
2690 IF I<>0 GOTO 2720
2700 PRINT "SPADES"
2710 RETURN
2720 IF I<>1 GOTO 2750
2730 PRINT "HEARTS"
2740 RETURN
2750 IF I<>2 GOTO 2780
2760 PRINT "DIAMONDS"
2770 RETURN
2780 PRINT "CLUBS"
2790 RETURN
2800 REM - COMPUTE VALUE OF PLAYERS HAND *****
2810 LET O(G)=0
2820 LET X(G)=0
2830 FOR I=1 TO 2
2840 LET N=P(G,I)
2850 GOSUB 2370
2860 LET X(G)=X(G)+N
2870 IF N<>11 GOTO 2890
2880 LET O(G)=O(G)+1
2890 NEXT I
2900 RETURN
2910 REM - SAVE THE CARDS THAT ARE ALREADY DEALT AND SHUFFLE
2920 LET K=T
2930 FOR I=1 TO R
2940 LET K=K+S(I)
2950 NEXT I
2960 FOR I=1 TO K
2970 LET A=A-1
2980 LET J=D(I)
2990 LET D(I)=D(A)
3000 LET D(A)=J
3010 NEXT I
3020 LET B=K+1
3030 GOSUB 1920
3040 RETURN
3050 REM - DEALERS LOGIC *****
3060 LET N=Q(1)
3070 PRINT "MY HOLE CARD"
3080 GOSUB 2470
3090 IF Y=0 GOTO 3130
3100 IF W<17 GOTO 3150
3110 IF W>17 GOTO 3260
3120 IF Z=0 GOTO 3320
3130 LET W=W-10
3140 LET Z=Z-1
3150 IF A<=F GOTO 3170
3160 GOSUB 2920
3170 LET N=D(A)
3175 LET T=T+1
3180 LET A=A+1
3185 LET Q(T)=N
3190 PRINT "I DRAW THE";
3200 GOSUB 2470
3210 GOSUB 2370
3220 IF N<>11 GOTO 3240
3230 LET Z=Z+1
3240 LET W=W+N
3250 GOTO 3100
3260 IF W<22 GOTO 3320
3270 IF Z=0 GOTO 3310
3280 LET Z=Z-1
3290 LET W=W-10
3300 GOTO 3100
3310 PRINT "I BUSTED ";
3320 PRINT "MY TOTAL IS ";W
3330 FOR I=1 TO K
3340 PRINT "YOU ";
3350 IF X(I)<>0 GOTO 3390
3360 PRINT "LOST ";
3370 LET V=V-H(I)
3380 GOTO 3480
3390 IF W<22 GOTO 3430
3400 PRINT "WON ";
3410 LET V=V+H(I)
3420 GOTO 3480
3430 IF W<>X(I) GOTO 3460
3440 PRINT "PUSHED ON ";
3450 GOTO 3480
3460 IF W<X(I) GOTO 3480
3470 GOTO 3360
3480 IF R<>1 GOTO 3510
3490 PRINT "THE HAND"
3500 GOTO 3520
3510 PRINT "HAND ";I
3520 NEXT I
3530 REM - PRINT THE PLAYERS WON/LOST STANDING *****
3540 PRINT
3550 PRINT "YOU'RE ";
3560 IF V<>0 GOTO 3590
3570 PRINT "EVEN"
3580 RETURN
3590 IF V>0 GOTO 3620
3600 PRINT "BEHIND $";V
3610 RETURN
3620 PRINT "AHEAD $";V
3630 RETURN
3640 REM - INSURANCE ROUTINE *****
3650 PRINT "INSURANCE (0-NO, 1-YES)";
3660 INPUT M
3670 IF M=1 GOTO 3690
3680 RETURN
3690 PRINT "YOUR INSURANCE BET ";
3700 IF W<>21 GOTO 3740
3710 PRINT "WINS"
3720 LET V=V+U
3730 RETURN
3740 PRINT "LOSES"
3750 LET V=V-U/2
3760 RETURN
3770 REM - END OF GAME WRAP UP *****
3780 PRINT "THANKS FOR PLAYING"
3790 PRINT "HOPE YOU ENJOYED YOURSELF"
3800 PRINT "HERE'S YOUR FINAL STANDING!"
3810 GOSUB 3550
3820 END
3830 REM - INSTRUCTIONS *****
3840 PRINT
3850 PRINT "THE DEALER STANDS ON 17 OR MORE,"
3860 PRINT " BUT WILL HIT SOFT 17"
3870 PRINT "YOU MAY SPLIT ANY PAIR."
3880 PRINT "YOU MAY DOUBLE ON THE 1ST 2 CARDS"
3890 PRINT " AND GET ONLY 1 MORE CARD."
3900 PRINT
3920 PRINT "USE THESE CODES TO PLAY:"
3930 PRINT " 0 - STAND"
3940 PRINT " 1 - HIT"
3950 PRINT " 2 - DOUBLE DOWN"
3960 PRINT " 3 - SPLIT A PAIR"
3970 PRINT
3980 PRINT "A ZERO BET ENDS THE GAME"
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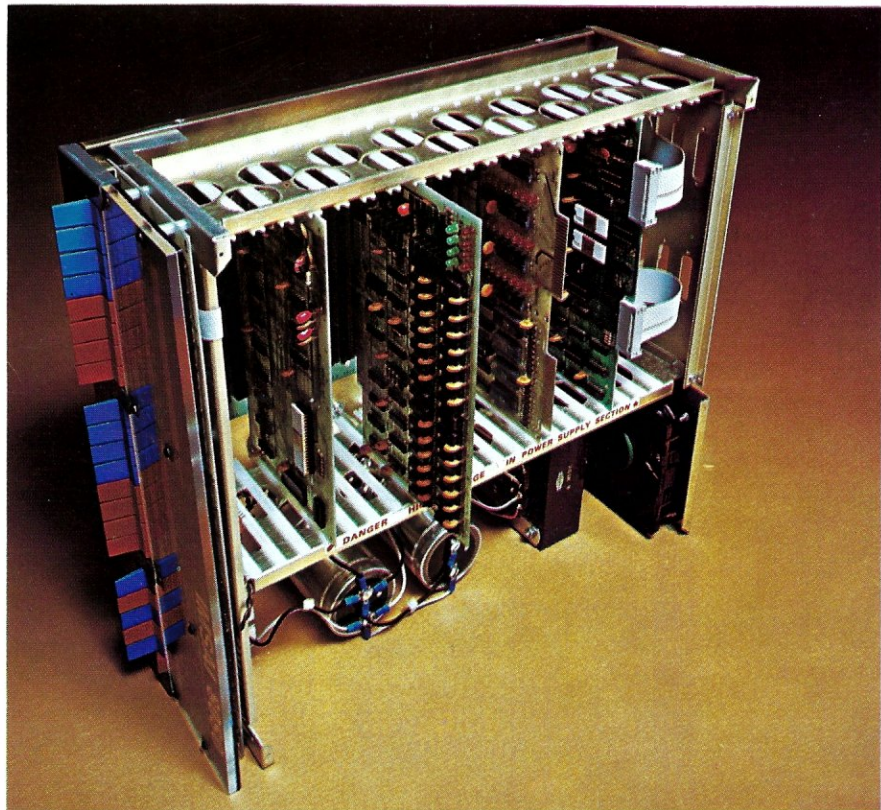
think IMSAI 8080.

Sure there are other commercial, high-quality computers that can perform like the 8080. But their prices are 5 times as high. There is a rugged, reliable, industrial computer, with high commercial-type performance. The IMSAI 8080. Fully assembled, it's \$931. Unassembled, it's \$599. And ours is available now.

In our case, you can tell a computer by its cabinet. The IMSAI 8080 is made for commercial users. And it looks it. Inside and out! The cabinet is attractive, heavy-gauge aluminum. The heavy-duty lucite front panel has an extra 8 program controlled LED's. It plugs directly into the Mother Board without a wire harness. And rugged commercial grade paddle switches that are backed up by reliable debouncing circuits. But higher aesthetics on the outside is only the beginning. The guts of the IMSAI 8080 is where its true beauty lies.

The 8080 is optionally expandable to a substantial system with 22 card slots in a single printed circuit board. And the durable card cage is made of commercial-grade anodized aluminum.

The IMSAI 8080 power



supply produces a true 28 amp current, enough to power a full system.

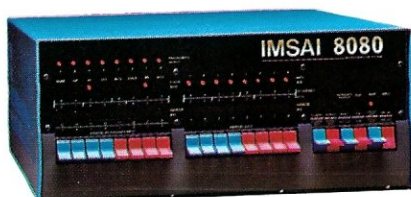
You can expand to a powerful system with 64K of memory, plus a floppy disk controller, with its own on-board 8080—and a DOS. A floppy disk drive, an audio tape cassette input device, a printer, plus a video terminal and a teleprinter. These peripherals will function with an 8-level priority interrupt system. IMSAI BASIC software is available in 4K, that you can get in PROM. And a new \$139 4K RAM board with software

memory protect. For the ultimate in flexibility, you can design the system for low-cost multiprocessor, shared memory capability.

Find out more about the computer you thought didn't exist. Get a complete illustrated brochure describing the IMSAI 8080, options, peripherals, software, prices and specifications. Send one dollar to cover handling.

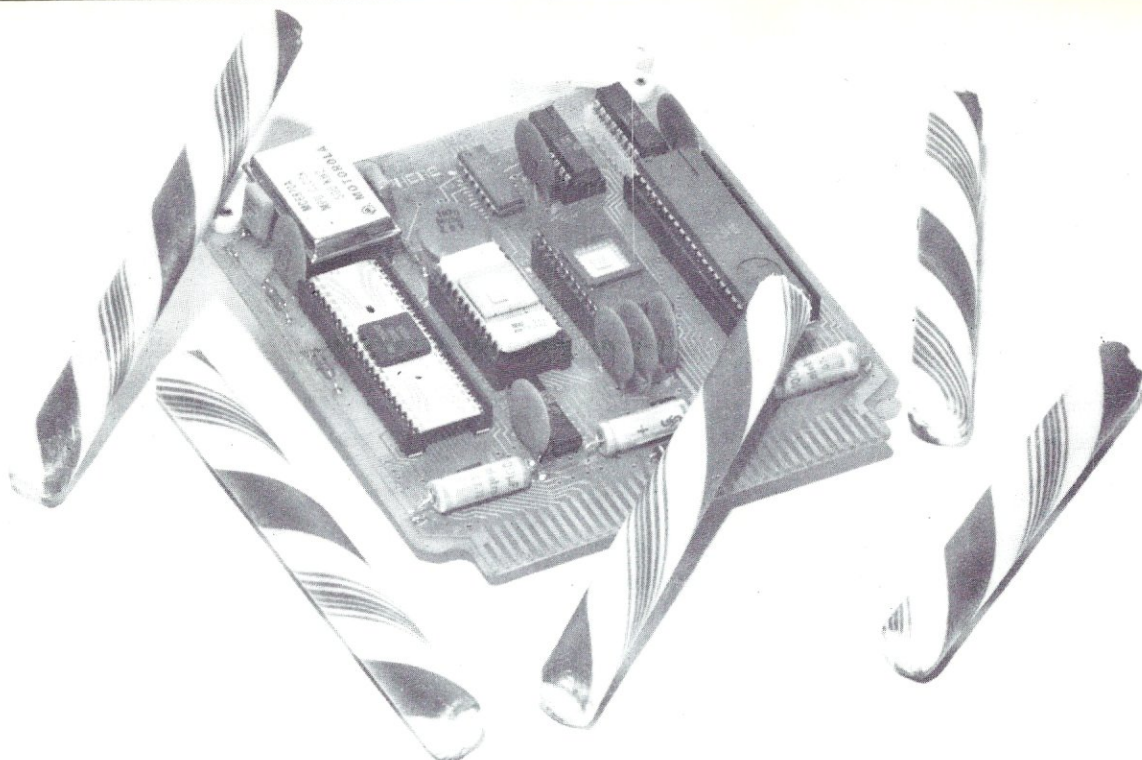
Call us for the name of the IMSAI dealer nearest you.

Dealer inquiries invited.



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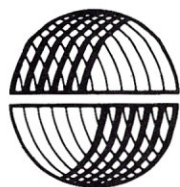
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rammed ROM'S. The static memory is expandable to 32K and you can control teletype or other I/O.

The TPU has a 72 pin edge connector with all the necessary signals to interface to almost any device. Use it to operate your sprinkling system, lights, heating/cooling system, security system or even control your electric train. The applications are limitless. The TPU/1 is completely assembled and tested; includes schematics and manual. FOR \$194 ITS ONE SWEET DEAL!



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